"Blowing down the line." This process, whereby natural gas is blown through the line to purge it of air and dust, is here being employed on a section of Southern California Gas Co.'s 20-inch Kettleman Hills gas transmission line.

The Sharples Process

—

The Processes of Contact Filtration

—

The Gyro Process
of
Vapor Phase Cracking

—

The Samplitt

—

The Mixitt

Petroleum Engineer

The Engineering Magazine of the Oil and Gas Industry

Volume 2 OCTOBER, 1930 Number 1

This issue contains

	Page
The Month's Highlights in Oildom By J. L. Dwyer	43
Welding of Manifolds and Repairs to Oil Lines By N. E. Wagner	44
Construction and Equipment of Great Lakes Gasoline Line By J. H. Dameron	46
Current Problems of Natural Gasoline By Emby Kaye	49
Development Methods in the Dundee Gas Field By K. C. Sclater	52
Refining Light Garber Crude By F. R. Staley	54
Progress of the Haynesville Pool Repressuring Project By Millard H. Flood	56
Change in Rig Set-up Reduces Vibration By A. L. Faber	65
South Plains Plant Treats Panhandle Gas	74
Soil Survey of the Quinton Gas Line By Roy Parker	79
West Asher Has First Blow-out	86
Trends in Proration Methods By H. S. Haury	90
Wynona Warehouse Has Equipment Protection Features	98
A Tour of the Eastern Oil Fields By B. H. Leonard	102
Problems of Modern Motor Lubrication By B. H. Lincoln and L. L. Davis	124
Activity Increasing in Eastborough Field	136
Handling High Voltage in Pipe Line Pumping Stations By L. M. Gullesen	138
The Physical Considerations of Pressure Control By Louis H. Brendel	142
Specifications of Aviation Oils By E. R. Irwin	151
Reducing Friction Losses in Bearings By John M. McGregor	160
Some New Developments in Well Surveying Apparatus By G. L. Kothny	168
Shackle Rod Problems in California Fields By W. A. Sawdon	181
Aerial Surveys Aid Pipe Line Location By Harry Nelson	184
Some Principles of Oil Field Motors By J. T. Hayward	190
Salt Water Pump Station at Valley Center	249
Dewaxing Heavy Vacuum Stocks by the Filter-Aid Method By Wm. P. Gee	251
Examples of Dynamometer Analysis on Pumping Wells By Mose D. Hodges	255
Operating Pipe Line Equipment in the Texas Panhandle By Max K. Watson	260
Oxygen and Petroleum Gases for Metal Cutting Operations By E. L. Mathy	270

REGULAR FEATURES

Pictorial Petroleum	231 to 246, inclusive
Progress of Major Pipe Line Work—	200, 201, 202 and 205
Latest Activities in the Oil Fields	206 and 210
New Petroleum Equipment—	212, 214, 217, 218, 220 and 223
Running Tour with Men in the Industry—	224 and 226
Laugh with Barney	228
New Petroleum Patents	276

SPECIAL NOTE: Each issue of The Petroleum Engineer is copyrighted. Any republication of the matter appearing in the magazine, either wholly or in part, is not permitted except by special authorization.

THE PETROLEUM ENGINEER PUBLISHING CO.
EXCHANGE BANK BUILDING TULSA, OKLAHOMA

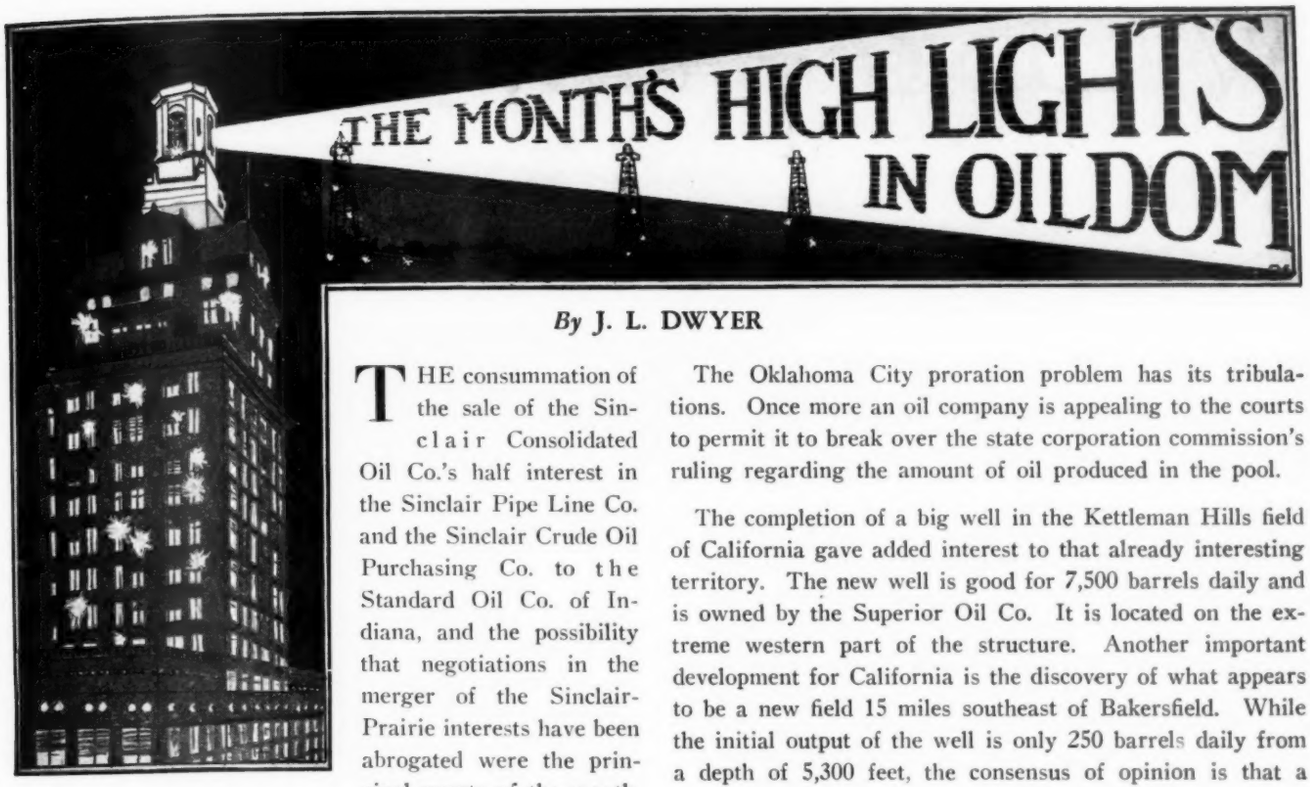
C. MORRIS - - - - - - - - *President-General Manager*
J. L. DWYER - - - - - - - - *Vice-President-Editor*
T. J. CROWLEY - - - - - - - - - *Vice-President*
W. T. BRYAN - - - - - - - - *Secretary-Treasurer*
W. L. LOVE - - - - - - - - *Advertising Manager*
K. C. SCLATER - - - - *Oil and Gas Production Editor*
J. H. DAMERON - - *Oil and Gas Transportation Editor*
F. R. STALEY - - *Refining and Natural Gasoline Editor*
WARREN L. BAKER - - - - - - - - *Associate Editor*

THE BIG PARADE

HURRAH! This is the day of the big elephants!—the heavy duty beasts of burden—the mark in trade that stands for the heavy duty bearings of Industry—a particularly popular sign in the industry of drilling.

American Roller Bearings are on parade everywhere there's drilling being done. They are carrying the colors of the leading equipment builders. They are lifting drilling equipment up to new standards of service.

WHY? - - - - - Ask anyone in "the big parade".



By J. L. DWYER

THE consummation of the sale of the Sinclair Consolidated Oil Co.'s half interest in the Sinclair Pipe Line Co. and the Sinclair Crude Oil Purchasing Co. to the Standard Oil Co. of Indiana, and the possibility that negotiations in the merger of the Sinclair-Prairie interests have been abrogated were the principal events of the month.

The fact that the Sinclair Consolidated Oil Co. ordered a quantity of twelve-inch pipe and started actual construction work on a pipe line which will run from the Oklahoma City field to Coffeyville, Kansas, was taken as an indication that the Sinclair interests held slight hopes of the merger being completed, and had therefore decided to construct a pipe line system of their own.

The daily average crude oil production of the nation continues to be held in check, and by the co-operation of the producing interests remains approximately half a million barrels daily less than this time one year ago. There is sufficient production held back by proration, however, to more than double the total daily production of the country if it were thrown on the market.

The Oklahoma City proration problem has its tribulations. Once more an oil company is appealing to the courts to permit it to break over the state corporation commission's ruling regarding the amount of oil produced in the pool.

The completion of a big well in the Kettleman Hills field of California gave added interest to that already interesting territory. The new well is good for 7,500 barrels daily and is owned by the Superior Oil Co. It is located on the extreme western part of the structure. Another important development for California is the discovery of what appears to be a new field 15 miles southeast of Bakersfield. While the initial output of the well is only 250 barrels daily from a depth of 5,300 feet, the consensus of opinion is that a find of importance has been made. This will mean some more deep drilling for California.

The Hobbs pool in New Mexico had several important extensions which broadened the area of the territory. The completion of new wells added considerably to the daily potential production of this area, which now approaches the half million barrel mark.

From an operating standpoint, the Oklahoma City pool shows a downward trend. There are less than 200 drilling wells in that field at present, and new locations are few and far between. There is on an average of one new location to every seven completed wells. Should this rate continue, the pool will be fairly well drilled up by the end of October; provided no important extensions are found.

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending September 13, 1930

(Figures in Barrels of 42 Gallons)

DISTRICT	Per Cent Potential Capacity Reporting	Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	3,313,000	77.8	5,428 000	11,192,000
Appalachian	91.8	589,000	71.5	1,140,000	1,105,000
Ind., Ill., Ky.	99.6	2,098 000	78.7	5,635,000	4,460,000
Okla., Kan., Mo.	89.3	1,887,000	65.3	2,553,000	4,828,000
Texas	90.4	3,994,000	80.1	5,674,000	10,662,000
Louisiana, Arkansas	96.8	1,088,000	59.3	1,308,000	2,006,000
Rocky Mountain	93.6	391,000	40.1	1,889,000	1,203,000
California	99.3	3,764,000	60.3	14,205,000	105,419,000
Total Wk. Sept. 13	95.6	17,124,000	69.4	37,832,000	140,875,000
Total Wk. Sept. 6	95.6	16,537,000	67.0	38,573,000	140,330,000
The Texas and Louisiana Gulf Coastal figures shown below are included above in the totals of their respective districts.					
Texas Gulf Coast	100.0	3,073,000	83.4	4,474,000	7,866,000
Louisiana Gulf Cst.	100.0	759,000	73.5	1,003,000	1,274,000

Daily Average Production

(Figures in Barrels)

	Sept. 13, 1930	Aug. 23, 1930	Sept. 14, 1929
Oklahoma	549,100	566,950	748,700
Kansas	118,550	114 650	129,000
Panhandle Texas	85,050	100,050	128,650
North Texas	67,450	72,550	97,400
West Central Texas	51,950	52,750	57,800
West Texas	268,150	280.150	365,050
East Central Texas	42,000	39,700	17,450
Southwest Texas	95,850	94,000	74,450
North Louisiana	39,850	41,500	35,150
Arkansas	53,550	55 050	63,900
Coastal Texas	179,200	177,050	135,850
Coastal Louisiana	24,250	26,800	20,500
Eastern (not including Mich.)	113,000	117,000	119,500
Michigan	8,150	9 850	18,000
Wyoming	53,150	50,250	57,000
Montana	9,050	9,450	11,800
Colorado	4,300	4,450	6,000
New Mexico	43,450	50,600	3,400
California	613,700	607,700	873,800
Total	2,419,750	2,470,500	2,963,400

WELDING *of* MANIFOLDS *and*

BEFORE welding progressed to its present stage, the method of building manifolds was the placing together of cast iron limbs and headers, which were made especially at the foundry or machine shop for each station and shipped to the station site. Today welded manifolds are made up in accordance with engineer's design, either at the station or at the shops.

Additional acetylene welded limb on main line manifold.

Where pipe is available and the necessary forged steel flanges and gates supplied, it is a simple procedure to fabricate a manifold at the location where it is to be installed, thus saving shipping costs on the fabricated manifold. A most satisfactory feature in the building of welded manifolds, is that should any changes be necessary after construction is begun, practically any angle or connection can be quickly made up to care for the change in plans. Another advantage of the welded manifold is its flexibility, which makes it easy to hold gaskets without breaking flanges. Still another advantage is that should such a mishap occur causing a limb to be split or bursted, it could be made up and replaced at the station in a very short time.

Originally manifolds were made up by welding nipples into flat steel flanges. Today, however, the long or short necked, or hubbed flanges, not only speed up the work but make it more simple and the fabrication of manifolds easier.

In some cases where new work is being started on stations the manifolds are built in place, but in most instances these are built in the yards and installed in place later. In the latter method of building manifolds, especially with the oxy-acetylene process of welding, it is necessary to have jigs or eye beams to hold the work while the welding is in progress.

Some manifolds made up by welding are very complicated, while others are rather simple, but regardless of various bends, connections and other intricacies of construction, it is easy for the welder to make up practically any desired fitting satisfactorily. The Prairie Pipe Line Company has made up a great number of manifolds, large and small, some of them more or less complicated, but has never yet had trouble with any of them. The oxy-acetylene process of welding is used entirely; however, some use the arc welding process with very good results.

There is a question between some foremen and welders as to which is the best method of saddling nipples to limbs or headers; the long, sharp point opening, or the rounded side opening. The writer prefers the rounded side opening, as it is the easier to line up and safer to weld, there being no sharp corners to contend with, which give the welder more or less trouble.

Welded manifold for gathering line station. All lines one size.

REPAIRS *to* OIL LINES •

By N. E. WAGNER,
Supt. of Welding,
Prairie Pipe Line Co.

When contemplating making up welded manifolds it is a good policy to pick out the very best welders obtainable, as not only is the welding more difficult, but the laying out and setting up procedure is no easy job. It is necessary to keep everything in line and in place so that when the manifold limbs and headers are completed they will go together without the usual flow of profanity from the pipe line superintendent or connection foreman.

Repairs to Pipe Line

After the oxy-acetylene process of welding was introduced in the laying of oil lines, it was also adopted for reconditioning of oil lines. On the first lines that were reconditioned the procedure was to displace the oil in the line, and then cut the line in sections, turning it for inspection. If the pipe was only slightly pitted, the pits were welded up with the torch. If the pipe was so badly pitted it would not pay to weld up the pit holes, the section of pipe would be cut out and replaced with new pipe. In some instances it would only be necessary to replace 15 or 20 feet of badly deteriorated pipe, while in some cases it would be necessary to replace as much as several joints in one section, this being left to the judgment of the inspector on the job.

Also bad collars (if on screw line) were cut out and butt welds made with the torch to place the line together again. This was an expensive procedure on account of it being necessary to raise the entire line, clean it, and make repairs at places necessary, thus moving sections of the line that really did not need to be disturbed had it been known these were in good condition.

It has now been determined that it is not necessary to raise an entire line from station to station, or from station to junction, as one joint may be found in bad condition, then several hundred feet, or for that matter several miles may be traversed before finding another joint or section that needs repairs. Therefore, most companies are changing their methods of repairing oil lines. There is today in operation on many pipe lines, the portable arc welding machine, with which repairs may be made whether the lines are empty or loaded. We go to the spot where we have placed a leak clamp, dig out each way from the spot until good pipe is found, then make necessary repairs with the arc welder. Sometimes many pit holes are welded up, and sometimes it is necessary to weld a slab over a large area. If a bad collar is encountered on screwed line, we either weld up the collar on both sides or place a split sleeve over the collar, making the longitudinal welds, then welding ends to line pipe; as mentioned before, this procedure can be carried on when line is either empty or loaded. By this method we only disturb the pipe it is necessary to repair, leaving the good pipe in the ground as originally placed. The bad spots are marked on the line, and the arc welder goes from one point to another along the line making necessary repairs. This method of reconditioning is more economical than the old method and can be done with a small crew.

Flanging up a station manifold.

Welded manifold. Main line station.

Construction *and* Equipment *of*

By J. H.

SOME twenty-odd years ago when pumping gasoline with steam-driven reciprocating pumps under conditions identical to long main-line operation was accomplished down on the Gulf Coast, probably little was thought of the far-reaching effect this phase of transportation would have in the future. Since then and until a few years ago very little was done toward transporting highly volatile refined products over long distances.

Not until the present year, however, did this phase of transportation gain favor with industry on a major scale, and when it did it arrived with the suddenness and proportions of something new and revolutionary. By the first of next year something like 243,000 gallons of refined products daily will have been taken away from rail movement out of the Mid-Continent alone. Two pipe lines will handle the tonnage. One, originating in the Texas Panhandle and terminating at St. Louis, Mo., will handle 18,000 barrels daily initially.

The larger of the two carriers is the Great Lakes Pipe Line Co. system with its 1,440 miles of main line winding its way through five states and to deliver gasoline at such principal cities as Kansas City, Omaha, Des Moines, Chicago and the Twin Cities in Minnesota. It also reveals a closer co-operation among competitive companies, in that six complete units in the industry have purchased stock in the organization fostered by the Continental Oil Co., of Ponca City and the Barnsdall Oil Corp., of Tulsa. In addition the Mid-Continent Petroleum Corp., Skelly Oil Co., Phillips Petroleum Co., which is building the Panhandle-St. Louis line, and the Pure Oil Co. have purchased stock in the carrier. In only two other instances have major transporters built lines jointly on a major scale.

This system, which will represent an investment in the vicinity of $16,000,000, will have many new and interesting engineering features. The line will be a 40,000-barrel capacity carrier initially and there is a strong probability its capacity will be increased soon after completion.

Pipe for the main lines will consist of 4-inch, 6-inch and 8-inch seamless and all of it will be 60,000 pound tensile strength pipe. It is being delivered in random lengths, the 8-inch running from 38 feet to 40 feet and weighing 28.554 pounds; the 6-inch averaging 31 feet and weighing 17.609 pounds and the 4-inch averaging 34 feet in length and weighing 8.635 pounds per foot.

All of the joints are being made by welding with a high test rod and specifications call for a low bead ripple weld. All of the welds are ⅛ of an inch in height and the width varies from ¾ of an inch on the 4-inch pipe to $\frac{13}{16}$ of an inch in width on the 8-inch.

Because so much of the success of operation depends on a tight joint, the designing engineers on the Great Lakes line insist on a rigid inspection of each weld, which possibly runs the construction cost slightly higher but insures better protection against dangerous as well as costly leaks.

Attached to each construction gang are three inspectors, all of whom are engineers working under a division engineer. Each engineer is assigned separately to the duty of inspecting welds, laying and ditching and some of the laying or ditching inspectors are combination men competent to inspect welds. In addition the contractors building the line have their inspectors.

These men check every weld upon its completion and if it does not have the appearance of a good weld it is couponed with a coupon-cutting machine. These machines are used to make frequent tests all along the line and with these and close inspections most of the faulty welds have been detected before a completed section of line was tested.

Upon completion of a five-mile section of line, one is bull-plugged, a gate put in the other and that section subjected to a 1,000-pound hydraulic test. Portable gasoline

Three construction scenes taken on the Great Lakes line near Bartlesville, Okla.

Great Lakes Gasoline Line

DAMERON

driven pumps are used to fill the line with water and build the pressure to 1,000 pounds. Each weld is then hammered to make certain it is holding.

Some of the pipe going into the line is middle welded at the mills with a new type of rod recently developed. By using this rod the pipe is heated a black-red color and the bead is virtually flush with the outside walls of the joint. Under tests these welds proved ductile and pulled apart at 70,000 pounds on the 60,000-pound pipe.

The stations are designed to be attractive, well ventilated and lighted; roomy and with foundations to minimize vibration. Each station will be constructed with 13-inch brick walls, steel roof deck with the roof covered with tar and gravel, and with a 13-inch brick fire wall between the engine room and pump side. A blank wall will be built in one end to minimize the cost of contemplated near future expansion.

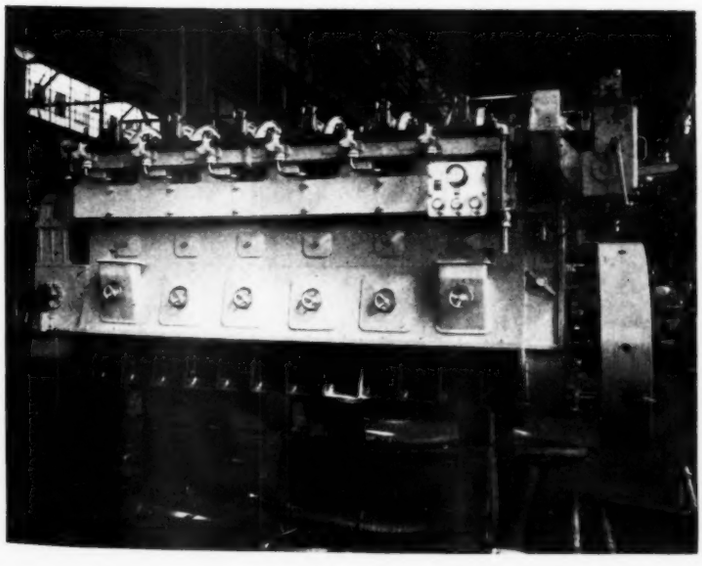
Another unusual feature is that the station will not have stand-by pumping units at present and still another is the introduction of a new type of Diesel to oil engine powered pipe line stations. Three sizes of engines are being installed; 6-cylinder units at the larger stations, 3-cylinder at others and 3-cylinder units with smaller bore and shorter stroke at the smallest stations. One of the features of these power plants is that parts are interchangeable on the larger size units and many of the parts for the smaller size engines are interchangeable with those of the larger engines.

These relatively slow speed units are full Diesel airless injection engines. On the 8-inch line stations will have two six-cylinder units driving as many 5¾ by 24-inch reciprocating pumps both rated to deliver 1,400 barrels hourly. The engines will develop 330 horsepower at 270 r. p. m. and have a 14-inch bore and 16-inch stroke. Stations on the 6-inch line will have two three-cylinder 14 by 16-inch engines developing 170 horsepower at 270 r. p. m., driving two 4⅝ by 18-inch pumps designed to discharge 570 barrels hourly together. The small stations on the 4-inch lines will have one three-cylinder engine at each station. These engines will have a 12½-inch bore and 16-inch stroke developing 120 horsepower at 270 r. p. m. Pumps in these stations are 4¼ by 12-inch pumps designed to discharge 175 barrels per hour.

Crankcases for the large engines will be halved and will be held to the engine block by 14 steel tie bolts running from the engine base to the concrete foundation and are designed to take the firing stresses of the engines. The base is one piece chrome nickel iron casting and the crankcases are made of cast iron. The bottom case is heavily ribbed and carries the crankshaft in seven main bearings. The engines are fitted with three plunger fuel pumps, fly-ball type governor, starting equipment and gauges and weighs approximately 60,000 pounds.

The pumps are specially designed for gasoline line work and are horizontal, duplex double-acting plunger pumps. They are relatively slow speed with a maximum r. p. m. of 40 while the r. p. m. of crude oil pumps of the same capacities is around 46 to 48 r. p. m. maximum. They are equipped with especially long packing boxes which have lantern rings through which lubrication is fed to the plunger with a high pressure lubricator similar to the type used for Diesel engine cylinder lubrication. The stuffing boxes are designed to prevent leakage of gasoline and at the same time prevent contamination of lubricating oil with the gasoline.

To minimize engine troubles originating from bad jacket water, each station is to be equipped with a water treating plant where the water contains 10 or more grains of hardness. Some of the stations will have a closed water circulating system to conserve the treated water. This system



With some modifications, this type engine will be used as a prime mover.

Ditching for the Great Lakes line.

essentially will call for added height on the cooling towers and running the engine water through tubes which will be cooled by raw water sprayed from the top.

Lubrication of each engine will be force feed and all lubricating oil will be settled and filtered before returning to the bearings. In connection with the cooling water system, an after cooler will be installed in the station through which the lube oil will pass before going to the overhead tanks. Water going to the engines will cool the hot oil several degrees before it reaches the bearings, but the water temperature will not be materially raised.

Fuel oil for the engines will be shipped to the stations in tank cars and stored in 1,000-barrel tanks at each station. Spur tracks will be built close to most of the stations and the fuel pumped from the racks to storage. Fuel going to the engines will gravitate to the fuel header from elevated flow tanks containing a four-day's supply of fuel oil. All fuel oil will be filtered.

Water for cooling the engines likewise will be flowed by gravity from elevated water tanks of sufficient capacity for two hours' supply. It will flow from the engine to the hot well and will then be picked up by a pump and returned to the overhead tank after being cooled.

Storage at each station will be variable with a minimum of one day's run for each grade of gasoline run through the line. All tankage will have floating roofs and it is estimated that the storage capacity on the entire line will be around 1,500,000 barrels. Incidentally, the line itself will contain a great amount of storage requiring around 300,000 barrels of gasoline to fill it.

Ethyl gasoline blending plants will be located at Kansas City, Des Moines, Omaha, Chicago and at St. Paul and Minneapolis. Possibly several short lines not more than four or five miles distant from the trunk will be built to bulk stations. It is also planned to take advantage of river shipping facilities in some places. The Continental Oil Company plans to utilize barges at Kansas City, Mo., and ship some products by water. At other points large fleets of trucks and tank cars will be used to distribute the products in those territories.

Another of the interesting construction features is the design of the manifolds which will permit doing virtually anything that is desired with the streams of gasoline. These cross type manifolds were designed by the company's engineering staff. To insure a tight joint at each flange connection specifications call for a raised face on all flanges and each face is ribbed similar to the fine grooving on a phonograph record. A gasket which fits inside the bolt circle is used and when tightened down makes a tight joint.

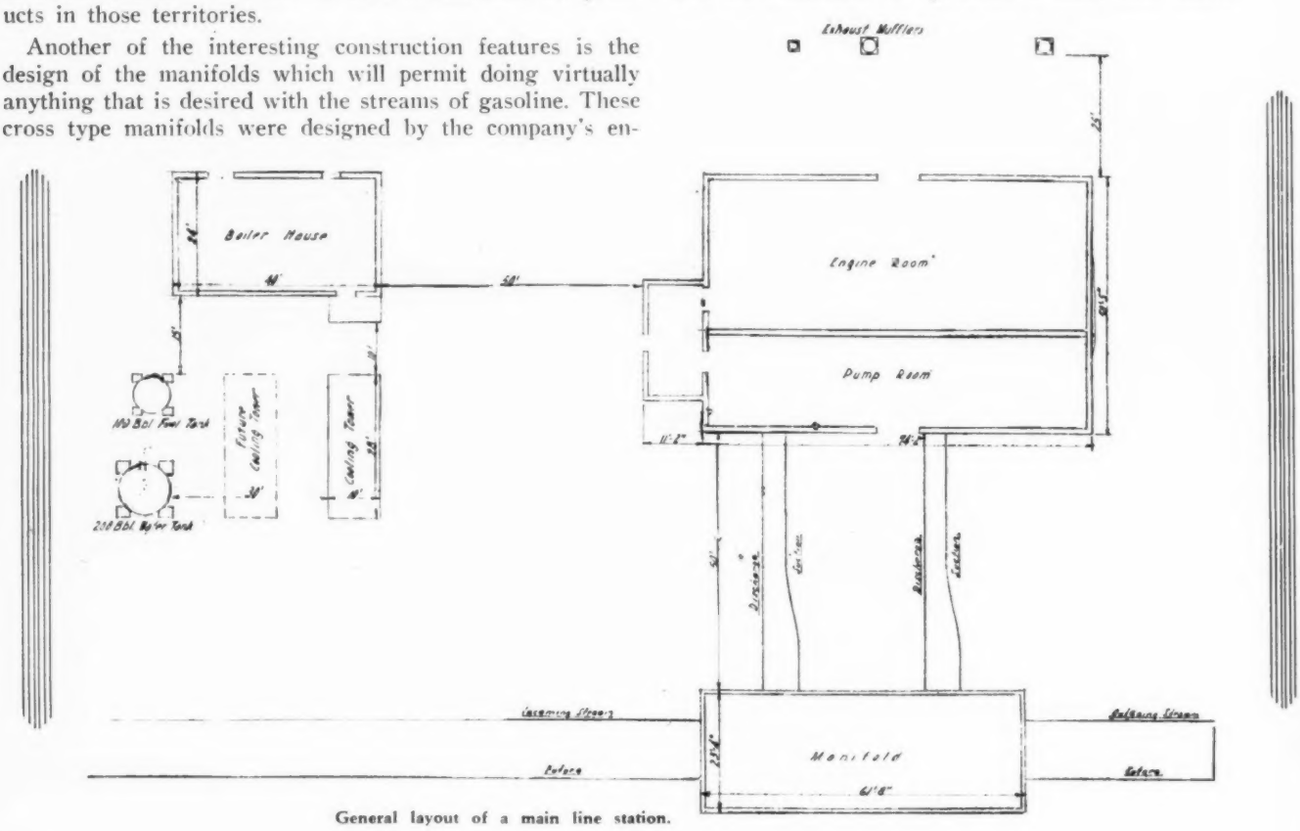
Rigid specifications have been made for the products to be whipped through the line and consequently checking evaporation losses is of paramount importance. Designing engineers estimate these will be very low and to accomplish this as little as possible of the gasoline on its way to storage at terminals will go into the surge or working tanks.

In operation the pumps at each station will discharge against a pressure of 800 pounds. The stations will be approximately 50 miles apart and the suction pressure will be around 16 to 18 pounds. Each station will have a surge storage tank floating on the line and any excess gasoline the pumps may not be able to handle will go into the vapor tight tank until such time as the pump can handle it. By following this method of pumping through each station and with a relatively small percentage of the gasoline going into the vapor tight tanks, evaporation losses are expected to be held at a very low percentage.

As one method of preventing some pipe lines losses, the builders of the line started line walkers on the job upon completion of the first section. Fearing that many will possibly attempt to tap the line before its completion so as to enhance the chances of petty pilfering of gasoline, a close watch is being kept for evidence of such attempts.

Because the carrier is to be a long life project, every effort is being made to select a personnel that will stay with the company for years. To this end brick cottages will be built at the main line stations to not only attract and hold a high type of employee, but to be as permanent as the line itself.

The line is expected to be in operation between the Mid-Continent and Kansas City, Mo., by the first of the year, and the remainder in operation a short time later.



General layout of a main line station.

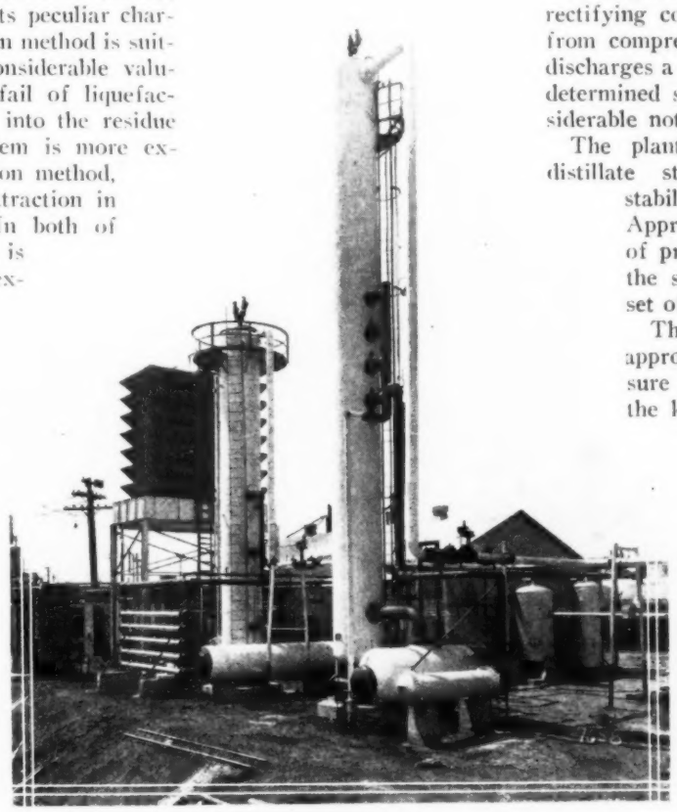
Current Problems *of* Natural Gasoline Manufacture

By EMBY KAYE,

General Superintendent, Natural Gasoline Department, Skelly Oil Co.

ALCHEMISTS did not spend a great deal of time trying to find processes for producing iron synthetically. Iron was too cheap. In the El Dorado days of the natural gasoline business high prices were not conducive to extensive research to improve manufacturing processes. Today the picture is different. The low market price of natural gasoline brought about by a combination of causes arising out of overproduction of crude oil, has whetted the desire of manufacturers constantly to improve their methods in order to reduce investment and operation costs without sacrificing plant efficiency.

Each of the three[1] processes of natural gasoline manufacture has its peculiar characteristics. The compression method is suitable for rich[2] gas, and considerable valuable gasoline components fail of liquefaction and are carried over into the residue gas. The absorption system is more expensive than the compression method, but is more efficient in extraction in the case of lean[3] gas. In both of these methods the efficiency is dependent to a very large extent upon the average atmospheric temperature. The charcoal process is suited almost exclusively to conditions where large volumes of lean gas are available at low pressures,[4] where extraction by compression is too inefficient, and oil absorption would require the installation of compression equipment. Charcoal absorption is practically as efficient at these low pressures as at the conventional 35 lbs. at which oil absorption plants are operated. The chief disadvantages of this process are the erosion, or contamination of the charcoal and the obsolescence of the plant, as and when, natural pressure has been reduced to the point where compression machinery is required to bring the gas to and carry it through the absorbing charcoal.



Unit in a natural gasoline plant.

While a great deal has been said about special equipment for the purpose of selectively absorbing the desirable hydrocarbons from a gas, yet with none of the processes referred to can all of the merchantable gasoline be extracted in finished form. Unless a good part of the lighter fractions is left in the gas, the condensate must be subjected to a process of rectification before the product can be properly classified and marketed. A simple process of rectification and liquefaction in one operation is an ideal which engineers have been seeking. The economies of such a simplified process are manifest.

The writer understands that C. A. Youker[5] experimented with "direct rectification" of refinery vapors at the Okmulgee plant of the former Waite Phillips Company. L. S. Gregory[6] discussed it in his paper before the Natural Gasoline Association Convention in 1928, but no commercial plant had come to the writer's attention. For some time, in natural gasoline plants of the Skelly Oil Company, uncondensed still vapors, vapors from surge tanks, storage tanks, etc., have been passed from compressors directly into rectifying columns in which the raw plant production is processed to certain salable grades.

A recent refinery installation,[7] where a rectifying column receives all plant vapors from compressors at a given pressure and discharges a finished natural gasoline of predetermined specifications, is attracting considerable notice.

The plant is a combination pressure distillate stabilizer, casinghead gasoline stabilizer, and vapor recovery plant. Approximately 60,000 gallons a day of pressure distillate are pumped to the so-called debutanizer through a set of heat exchangers.

The debutanizer is a column with approximately fifteen trays. The pressure distillate flows downward into the kettle where it is heated to approximately 300 degrees F. at a pressure of 30 lbs. This temperature depropanizes the pressure distillate in a sloppy cut; that is, the reflux ratio over the column is very small and the amount of heavier hydrocarbons leaving the pressure distillate is quite large. From 15 to 20 per cent of pressure distillate thus leaves the debutanizer. The stabilized pressure distillate flows through a heat exchanger into the final cooler. The propane content of the finished pressure distillate can be reduced to nothing if so desired. The vapors from the top of the debutanizer flow through a back pressure regulator into a condenser where they are cooled to about 80 degrees F. Part of the condensate is pumped as reflux over the tower while the excess overflows into mixing tanks, where it is mixed with casinghead gasoline and other condensate on its way to the main stabilizer. The uncondensed vapors, together with the vapors from the look boxes, gasoline storage tanks, pressure distillate separator, topping still separator, and other sources, are compressed

[1] Compression, oil absorption and charcoal.
[2] 2 gallons per M cu. ft.
[3] 1 gallon and under per M cu. ft.
[4] 5 to 20 lbs.
[5] Supt. Phillips Pet. Co. Refinery, Borger, Tex.
[6] L. S. Gregory, Engineer, Black, Sivalls & Bryson, Oklahoma City.
[7] Kanotex Refining Co., Arkansas City.

to a pressure of 300 lbs. The condensate from the intermediate pressure coolers is sent to the mixing tanks, previously referred to. The vapors leaving the compressors at 300 lbs. are conducted directly into the stabilizer without cooling, at a temperature of 180-200 degrees F. The mixed condensate from the mixing tanks is pumped to the same stabilizer through a series of heat exchangers and a preheater, and enters the column at the same point with the vapors from the compressors. A constant pressure of 300 lbs. is kept on a stabilizer by a back pressure regulator, set in between the reflux condenser and the column. The vapors and gases leaving the column are condensed in cooling sections, from which the condensate and the dry gas flow through a separator. A constant volume of reflux is pumped from the separator into a stabilizer. A novel feature for maintaining the level of reflux in the separator consists of a supersensitive liquid level control, which operates a secondary back pressure valve on the discharge of the gas from the separator. Should the amount of condensate be more than that desired for reflux, and the condensate level rise in the separator, the liquid level control opens the by-pass valve and reduces the pressure on the condensers. With reduced pressure on the condensers, less condensate is accumulated, thus bringing the level in the condensate receiver to the desired height.

The temperature of the kettle at the bottom of the main column depends entirely upon the recovery product desired. A propane-free product, with a distillation recovery of all the way from 75 per cent to 99 per cent, can be easily obtained by varying the temperature of the kettle. The uncondensed gases leaving the column are completely stripped of pentane and heavier fractions, while the amount of butane left depends entirely upon the recovery of the product desired. A charcoal test of the vapors showed less than 1 cc. condensed from 100 cu. ft. of gas run into the tester, or .0028 G. P. M., which is considerably less than that obtained in standard absorption vapor recovery or gasoline plants.

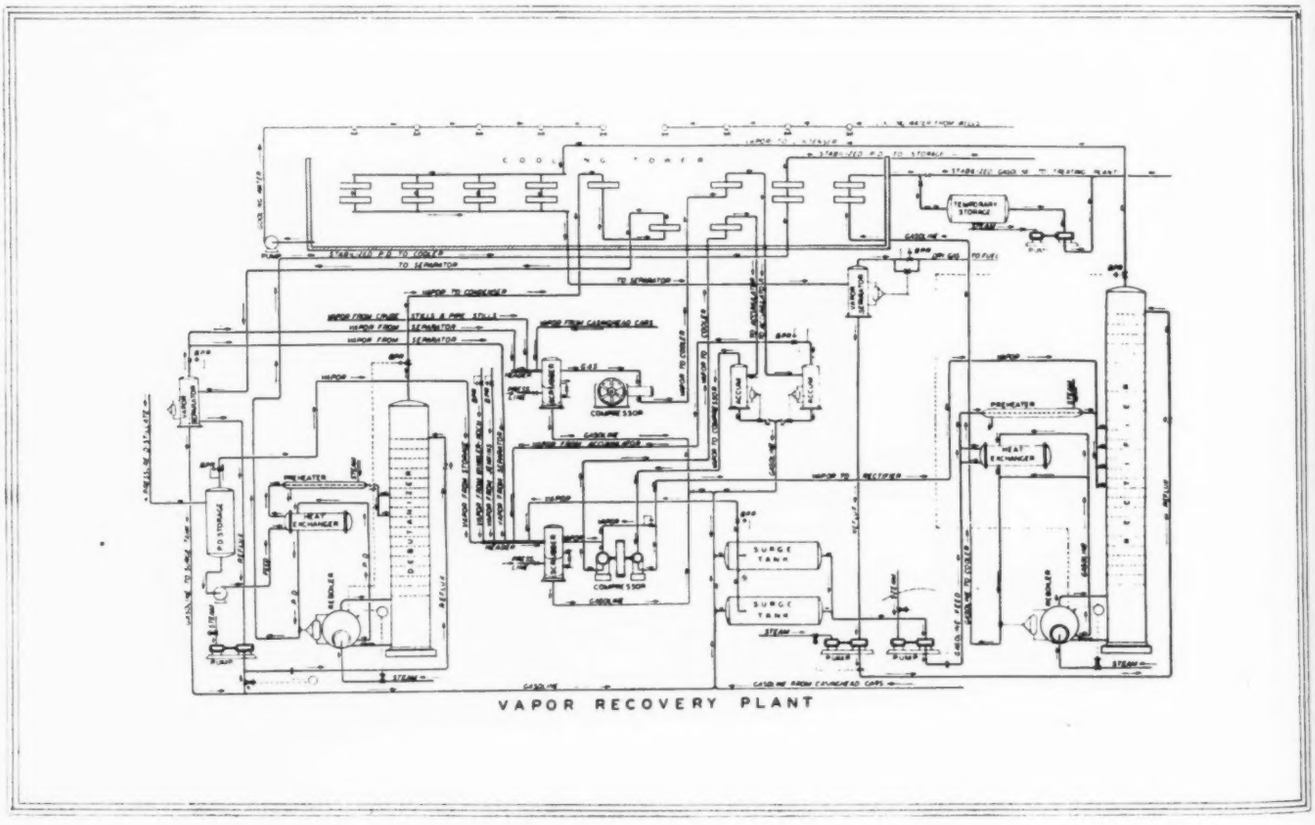
The total steam consumption of the plant is comparatively small, since the temperature of the vapors and the gasoline introduced into the main stabilizing column are almost equal to their final desired temperatures, due to heating from interchangers and compression. The amount of water circulated is also small, because the compressed vapors are fed into the tower as they come from the machines, uncooled.

The plant is equipped with both electric and air actuated controls and is automatic in operation, requiring a minimum of attention from the operators. The feed of the condensate and casinghead gasoline to the column, though controlled by constant volume control, is changed as desired to meet the refinery requirements. This change does not upset the operating conditions of the tower and the desired product of uniform quality is produced throughout the day.

One of the greatest saving of this plant is the low consumption of steam and water, and thus a low operating cost per gallon of gasoline recovered or stabilized.

Direct stabilization will no doubt find its way as a process for the selective extraction and liquefaction of desirable hydrocarbons from casinghead gas. The first units will be in rich gas in high vacuum installations. In plants processing gas from 5 to 20 gallons per thousand cu. ft, the gasoline is obtained by compression. The vapors are cooled and the condensate heated in the rectifying column. This primary condensing will be avoided as will the evaporating of the condensate, an important saving where fuel is an item often running as high as 25 per cent of the total operating cost (including raw gas). The gasoline now left in the residue gas, will be practically completely extracted.

How far this form of processing will go as regards leaner gas, will depend upon future developments. Suffice it to say that a more economical method for treating rich vapors or gas has been developed and is being demonstrated in commercial installations. What follows cannot but be a boon to natural gasoline manufacturers.



VAPOR RECOVERY PLANT

Dresser Couplings Dominate
FOR
HANDLING GAS
IN
OKLAHOMA
DRESSER COUPLINGS—speeding the development of wells in this great producing area . . . making it possible and practicable to deliver Oklahoma gas to far distant markets—keeping over 100,000 miles of pipe lines permanently joint-tight.
S. R. DRESSER MANUFACTURING CO.
Bradford, Pennsylvania

When writing S. R. Dresser Mfg. Co. *please mention The Petroleum Engineer*

Development Methods . . . Employed in DUNDEE

By K. C.

ALREADY well known as a summer playground, the Finger Lakes District in the north central part of New York State has acquired an added interest by reason of the recent discovery of a commercial gas field within its confines. Early in 1929, with the bringing in of a well near the town of Dundee, a gas field was discovered. The well was drilled in what is designated as the Tyrone Structure, which is located roughly in the area between the small towns of Dundee and Altay, Tyrone Township, Schuyler County, New York State. The field has been named the Dundee gas field. With reference to cities in the vicinity, it is situated about 40 miles northwest of Elmira and about 30 miles almost due west of Ithaca.

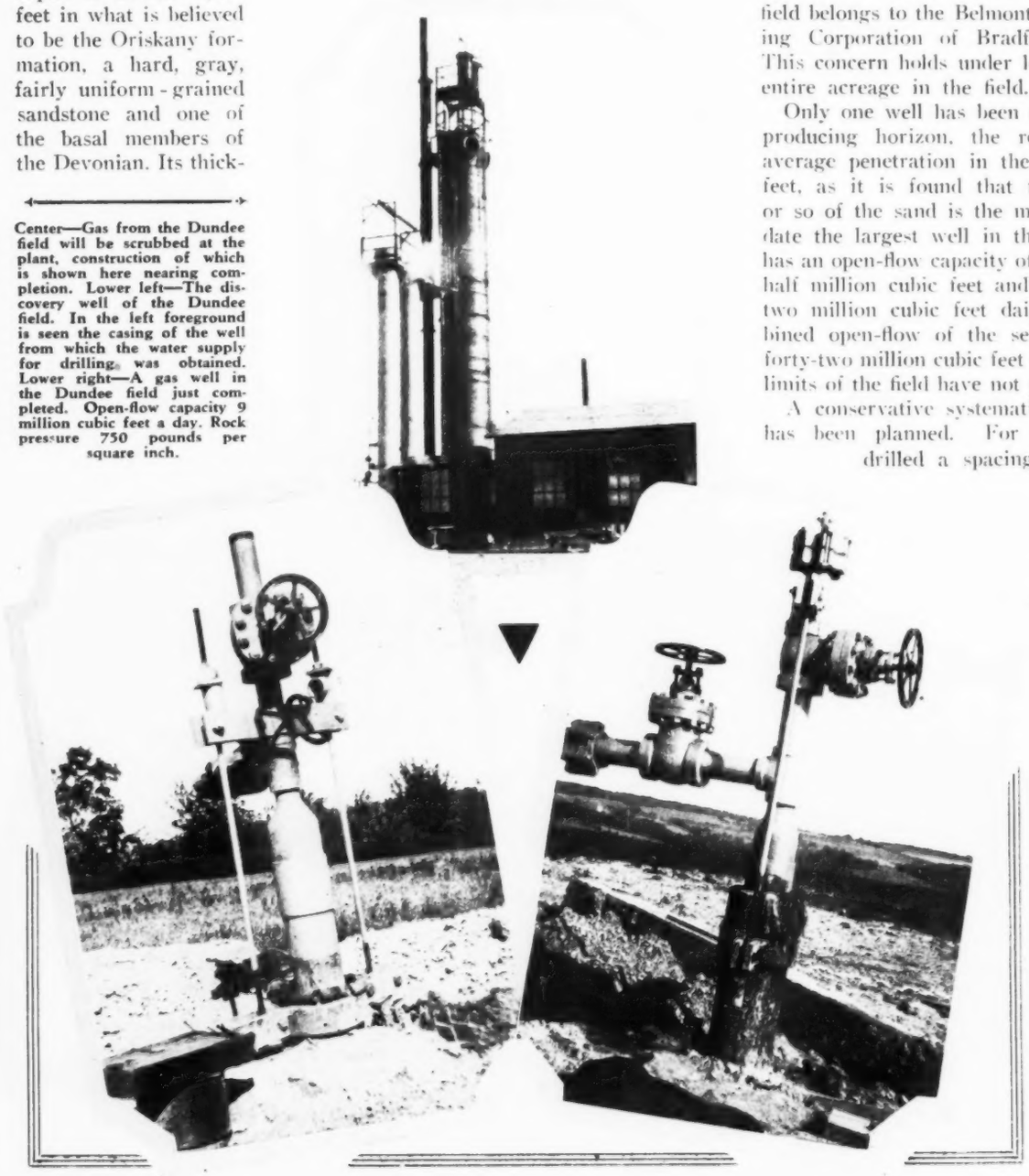
Gas is found at a depth of about 2,000 feet in what is believed to be the Oriskany formation, a hard, gray, fairly uniform-grained sandstone and one of the basal members of the Devonian. Its thickness in one well drilled is 35 feet. A black flinty limestone about 100 feet in thickness, and assumed to be the Onandaga formation, overlies the gas-bearing horizon. This has proved to be an excellent marker. Immediately above the Onandaga about 40 feet of Marcellus shale or Romney formation is penetrated. In Ohio and Kentucky this formation contains gas.

This is a field of what might be considered as relatively hard-rock drilling. The formations are predominantly limestone with some hard shale. To date seven wells have been drilled and completed as gas wells. Drilling has been done entirely with standard cable tools. At present the wells are closed in pending the completion of pipe line connections. Credit for the discovery of the field belongs to the Belmont Quadrangle Drilling Corporation of Bradford, Pennsylvania. This concern holds under lease practically the entire acreage in the field.

Only one well has been drilled through the producing horizon, the remainder have an average penetration in the sand of about 14 feet, as it is found that the upper ten feet or so of the sand is the most productive. To date the largest well in the field brought in, has an open-flow capacity of about ten and one-half million cubic feet and the smallest about two million cubic feet daily, while the combined open-flow of the seven wells is about forty-two million cubic feet of gas per day. The limits of the field have not yet been defined.

A conservative systematic drilling program has been planned. For the wells already drilled a spacing of one well to 20 acres has been used. Probably this spacing will be adhered to as closely as property lines will permit.

Tests made on the gas reveal that it is very dry, consisting of 97 per cent methane. It carries sulphur in sufficient quantity to necessitate treatment before marketing. On the northeast edge of the field a treating plant for scrubbing the gas has been constructed. Here the gas will be treated before it enters the pipe line of the Columbia Gas and Electric Corporation, to whom the



Center—Gas from the Dundee field will be scrubbed at the plant, construction of which is shown here nearing completion. Lower left—The discovery well of the Dundee field. In the left foreground is seen the casing of the well from which the water supply for drilling was obtained. Lower right—A gas well in the Dundee field just completed. Open-flow capacity 9 million cubic feet a day. Rock pressure 750 pounds per square inch.

GAS FIELD *Are Simple but Effective*

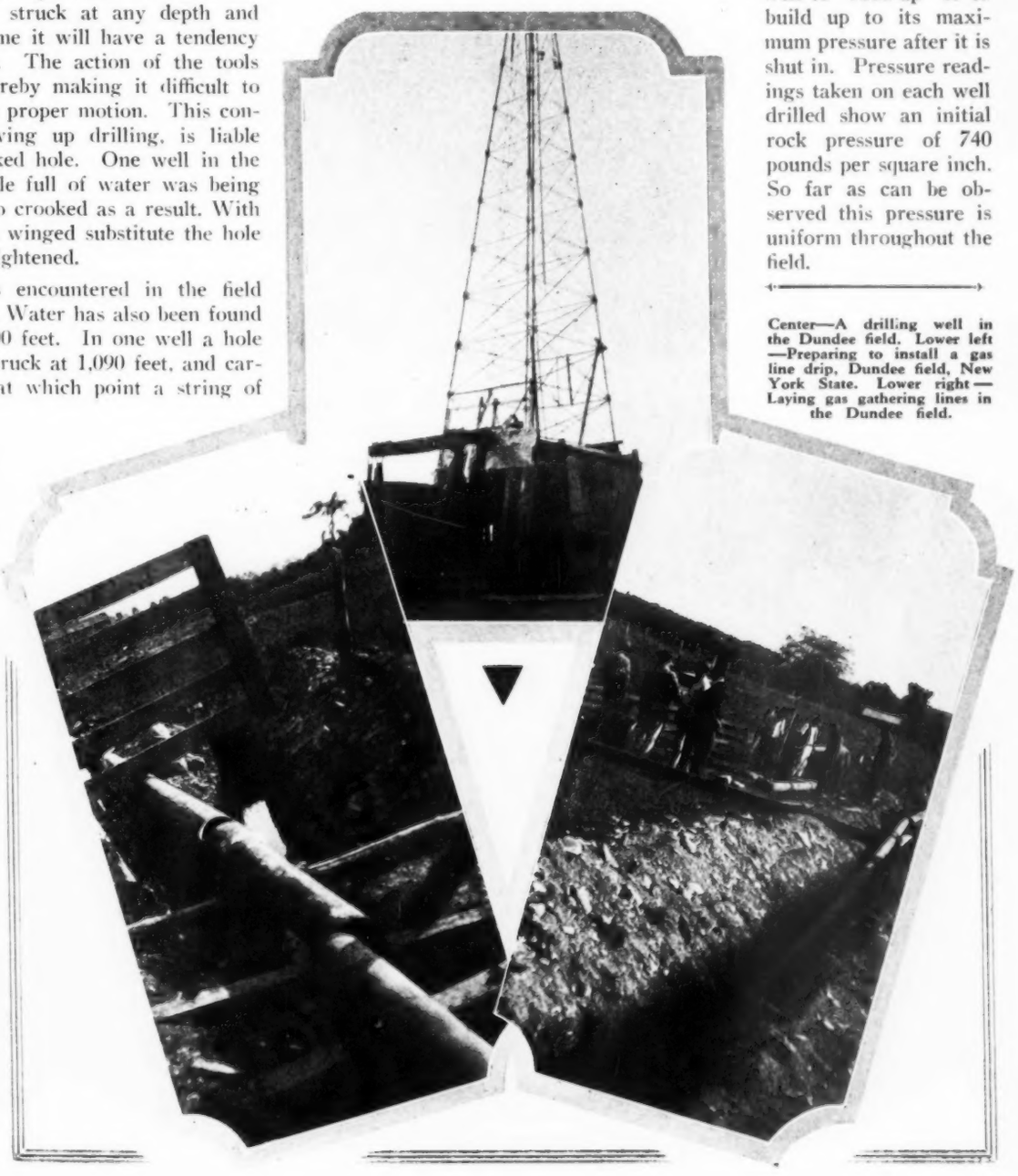
SCLATER

gas will be sold. Pipe line connections and construction of the scrubbing plant are about completed and it is expected to turn gas from the field into the pipe line along about the latter part of September. Thus far the drilling and completion of wells in this field have offered no particular difficulties. Drilling is all done by contract and standard cable tools, with 81-foot standard steel derrick, have been found quite satisfactory. Good drilling time is made and has averaged from 80 to 100 feet per day. All drilling is done with a steel cable, to the end of which is spliced 250 feet of manila cable as a cracker. The use of a cracker on a steel line is still common practice in the Pennsylvania fields. Usually when a cracker is used, and water is struck at any depth and carried for some time it will have a tendency to slow up drilling. The action of the tools becomes "logy" thereby making it difficult to "feel" or impart the proper motion. This condition, besides slowing up drilling, is liable to result in a crooked hole. One well in the field in which a hole full of water was being carried started to go crooked as a result. With the skillful use of a winged substitute the hole was eventually straightened.

Surface water is encountered in the field from 45 to 165 feet. Water has also been found between 600 and 900 feet. In one well a hole full of water was struck at 1,090 feet, and carried to 1,290 feet at which point a string of casing was set.

Surface casing consists of 40 feet of 10-inch, 32-pound drive pipe, with a 16-inch heavy steel shoe. This is set through the glacial drift which blankets the surface of this region. To shut off the surface water, 275 to 280 feet of 8¼-inch 24-pound casing with an 8-inch light steel shoe is used. Unless water in quantities is encountered below the 8¼-inch casing, a string of 7-inch (O. D.) 24-pound seamless casing is set as a finishing string with an anchor packer and a perforated joint on bottom. In the well already referred to, which encountered water at 1,090, a string of 7-inch 24-pound seamless casing with a heavy steel shoe was set at 1,290 feet. The top of the sand was struck at 2,054 feet and the well drilled 10 feet into the sand to a total depth of 2,064 feet. This well was completed with a string of 4-inch 11-pound tubing with a gas anchor packer and a perforated joint on bottom.

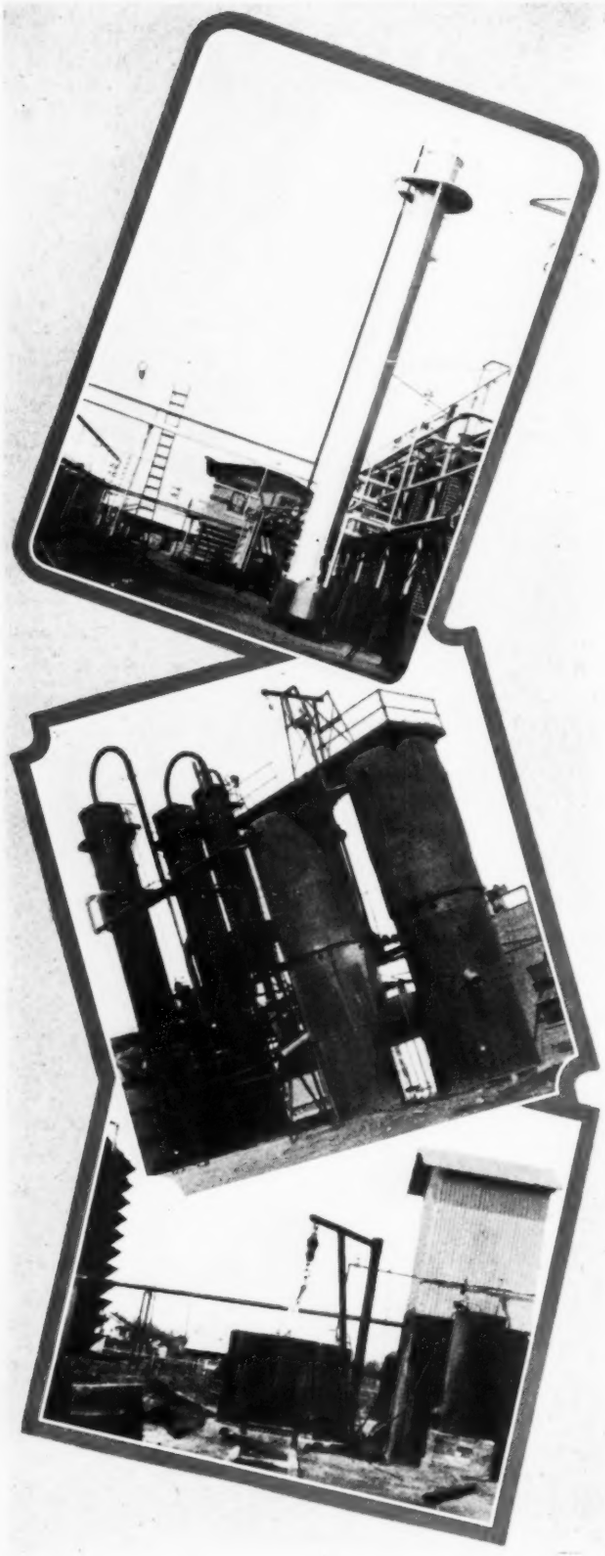
While drilling a well there is practically no loss of gas, as the wells are equipped with a control head and oil saver. When a well has reached the desired depth it is completed in short order. Within a few hours the casing is landed, the casinghead connection installed, an open-flow test of the well's capacity made, and the well closed in. It takes but a few minutes for a well to "rock-up" or to build up to its maximum pressure after it is shut in. Pressure readings taken on each well drilled show an initial rock pressure of 740 pounds per square inch. So far as can be observed this pressure is uniform throughout the field.



Center—A drilling well in the Dundee field. Lower left—Preparing to install a gas line drip, Dundee field, New York State. Lower right—Laying gas gathering lines in the Dundee field.

Refining Light Garber Crude

By F. R. STALEY



THE Garber Refining Company's refinery at Garber, Oklahoma, has recently completed an extensive improvement under the direction of H. L. Welton, superintendent of the plant.

The refinery processes 3,500 barrels of Garber crude per day. The distillation unit consists of a battery of six shell stills and a pipe still for topping the crude. Each of the stills, including the pipe still, is equipped with a fractionating tower, resulting in a very flexible installation, permitting the manufacture of a variety of gasolines of different end points or gravity.

The light Garber crude has a gravity of 42 A. P. I. The gravity of the streams from the towers are as follows:

Vaporizer	75.5	A. P. I.
No. 1 Still	65.5	"
No. 2 Still	55.8	"
No. 3 Still	54.0	"
No. 4 Still	50.5	"
No. 5 Still	46.5	"
No. 6 Still	42.0	"

The residue from the sixth shell still in the battery is fed to the p'pe still by means of a hot oil reciprocating pump. This oil enters the pipe still at 650 degrees F. and the outlet temperature is about 800 degrees F. The gravity of the hot oil is approximately 29.5 A. P. I.

The pipe still charge represents about 35 per cent of the crude. Gas oil cut of 32-33 A. P. I. gravity is made on the fractionating tower of this still. This represents about 25 per cent of the crude. The residue is 20 gravity fuel oil.

Gas oil is used in the trim coils of the towers. The hot gas oil is then pumped through heat exchangers against the crude oil charged to the battery. The gas oil from these heat exchangers is then cooled in water cooling coils.

The gas oil is cracked in a Jenkins unit. These units are equipped with Gray towers, for treating the distillate in the vapor phase.

No acid is used in the plant for treating the light oils.

Both the straight run and the cracked gasoline is sweetened with sodium hypochlorite in a continuous closed treating system. The kerosene is sweetened with the same reagent, using no acid.

The sodium hypochlorite is manufactured at the plant from sodium hydroxide solution and chlorine gas received in cylinders.

The refinery manufactures several grades of gasoline of high gravity and low end point. It also has an Ethyl blending plant for treating Ethyl gasoline.

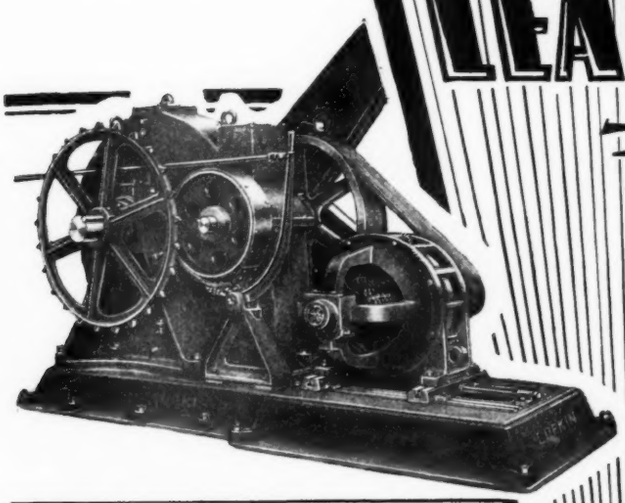
One of the features of the plant is the new efficient vapor recovery system. All of the gasoline tanks are hooked up for collecting vapors. A slight pressure of one-half inch of water is carried on the system, which is nicely regulated. A compressor takes the vapor from the gathering lines and discharges it through a gas cooler to the absorber at a discharge pressure of approximately ten pounds per square inch. A 49 A. P. I. gravity naphtha is used for absorption oil.

Top to bottom—Absorber. Cracking unit. Treating tank. All at the Garber Refining Co.'s plant, Garber, Okla.

LUFKIN ALWAYS LEADING

The LUFKIN HERRINGBONE UNIT FOR PUMPING AND PULLING

The LUFKIN WORM GEAR UNIT FOR PUMPING AND PULLING



Specify LUFKIN Equipment

THE Sykes-Herringbone Gear Type of Unit is the latest and most popular type of the line of Lufkin Pumping Units. Designed to stand the most severe operating conditions the Herringbone Unit is found readily adapted to the oil field pumping use.
The Sykes-Herringbone Gears used in this Unit are of heavy construction, are superior in strength and are silent in operation. Freedom from back-lash; continuity of tooth contact and maximum tooth surface for width of gear face, are features of this type gearing. This Unit is most easily adapted to any type of power drive, particularly single cylinder gas engines. Having the right kind of "fall" makes this Unit ideal for cable tool drilling.

THE Lufkin Worm Gear Unit is the original perfected Lufkin Unit. This Unit employs the use of a Nickel Alloy Steel, heat-treated steel worm driving a special bronze gear. It is furnished for either direct connection to electric motor or gas engine and is also furnished with "V" belt drive to accommodate regular motors. It is also furnished for connection to single cylinder gas engine. Many operators maintain that the Worm Gear is the most practical pumping Unit.

We recommend both and say it is a matter of choice—"some prefer blonds, some brunettes", but there are jobs where one Unit is more practical than the other.

Manufactured at Lufkin, Texas, by
THE LUFKIN FOUNDRY AND MACHINE CO.

THE LUFKIN LINE

District Offices
Tulsa, Okla. Houston, Texas

THE LUFKIN LINE

Los Angeles, Cal. Seminole, Okla. El Dorado, Ark. Odessa, Texas New York, N.Y.

Use Scissors Here

We are interested in Economical Oil Production equipment.
PLEASE SEND COMPLETE CATALOGUE
NAME
COMPANY
CITY
STATE

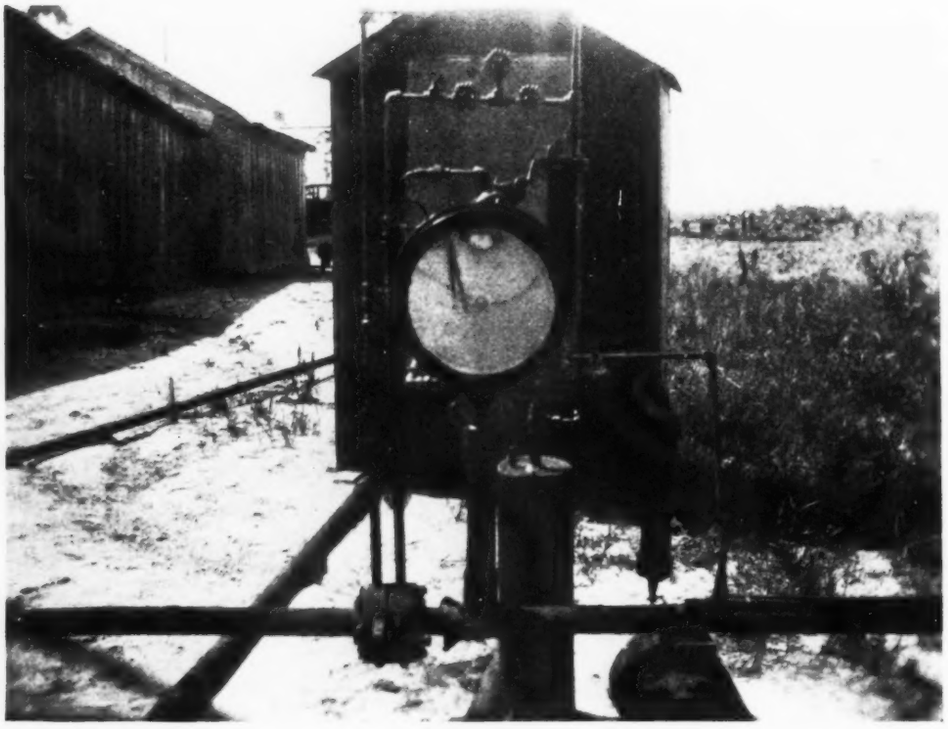
When writing LUFKIN FOUNDRY & MACHINE CO. *please mention The Petroleum Engineer*

Development and Progress of the » » »

Haynesville Pool Repressuring Project

By MILLARD H. FLOOD,

Petroleum Engineer, Louisiana Oil and Refining Corporation



View showing the details of recording meter connections on key well gas injection line.

ONE of the most recent, and it is believed one of the largest, repressuring projects to get under way was started early this year in the Haynesville Pool, Louisiana. Drilling started in this pool in 1921 and continued until 1924, when the pool was completely developed. Vacuum was first applied to the sand in the fall of 1923. Its application has been continued up to the present. The producing horizon is the Blossom sand which lies at an average depth of 2,800 feet.

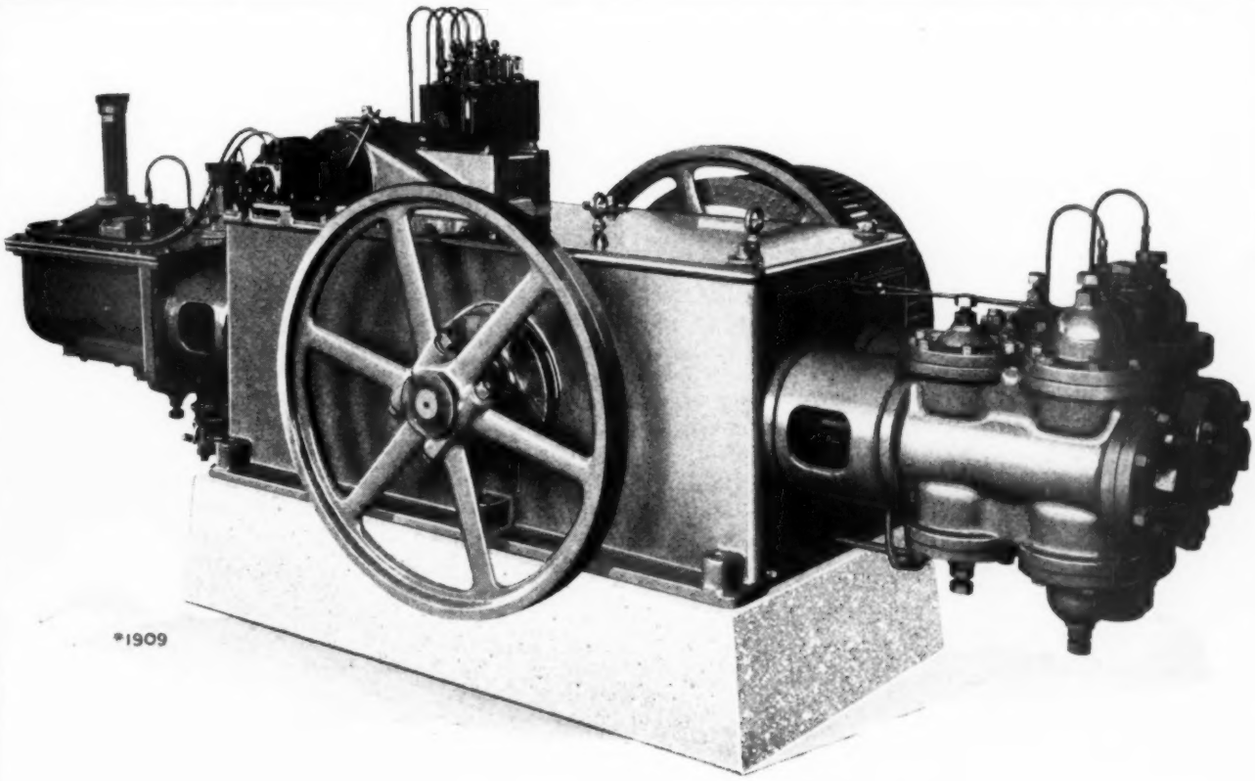
To determine the feasibility of repressuring the sand, experimental field work was started August, 1929. Two wells, the Reserve Petroleum Company's No. 3 Goodwin in the SW NW NW of Section 15 (see accompanying map) and the Louisiana Oil and Refining Corporation's No. 5 Beene in the NW SE SW of Section 15, were selected as key wells and 35 thousand cubic feet of gas per day per well injected from August to December 1929. These and the surrounding wells had been produced under vacuum prior to the injection of gas. As the effects of the injected gas began to be felt on the surrounding wells, the vacuum on these would gradually be reduced and the pressure reduced to atmosphere. Except for bypassing in a few wells and a slight decrease in production when the vacuum was removed, very good results were obtained. With the satisfactory showing made, the experimental work was discontinued and plans laid for a repressuring program for the field. Three companies, the Reserve Petroleum Company, the Ohio Oil Company, and the Louisiana Oil and Refining Corporation entered into the project on a co-operative working agreement whereby the services of an engineer familiar with repressuring operations were engaged to supervise the technical phases of the work.

At the present time the project comprises 3,640 productive acres on which are 310 producing wells, of which 229 wells on 2,640 acres are operated by the Ohio Oil Company, 41 wells on 520 acres by the Reserve Petroleum Company, and 41 wells on 480 acres by the Louisiana Oil and Refining Corporation.

Repressuring operations proper were started March 8, 1930, when 13 key wells, including the two experimental injection wells, were selected on the basis of one key well to seven producing wells, or one injection well per 80 acres. The key wells are indicated by circles on the accompanying map. Nine are on the Ohio Oil Company's acreage, two each on the acreage of the reserve Petroleum Company and the Louisiana Oil and Refining Company.

Dry gas is used for injection purposes. The initial volume of injected gas per key well was 30 thousand cubic feet. This amount has been gradually increased until at present the injected volume per key well is 75 thousand cubic feet per day. Satisfactory results have been obtained by injecting the gas into the casing. Each key well is equipped with a volume control to regulate the quantity of gas going into the well. Also the volume of injected gas is measured by a recording orifice meter to which the volume control is connected (see accompanying photographs).

In the field the Blossom sand varies in thickness from 5 to 50 feet. These extreme variations in thickness are due to the lenticularity of the sand. Over the major part of the field, however, the sand is fairly uniform in thickness.



A Baby Booster for the Tulsa Show

BLOCK C

A tiny little fellow with a real mission.

In gas fields where the wells are too small to be profitable, is where this baby shines.

Put a TRANSIT Baby Booster at each well and see your profits increase.

Simple, automatic, enclosed water system with radiator, enclosed flood lubrication, Timken bearings and other good features.

See it at the Tulsa Show

Agents

FRICK-REID SUPPLY CORPORATION
Tulsa, Okla., or any store.

REPUBLIC SUPPLY COMPANY of California
Los Angeles, California

E. L. WILSON HARDWARE CO.
Beaumont, Texas.

NATIONAL TRANSIT
Pump & Machine Co.
Oil City, Pa.

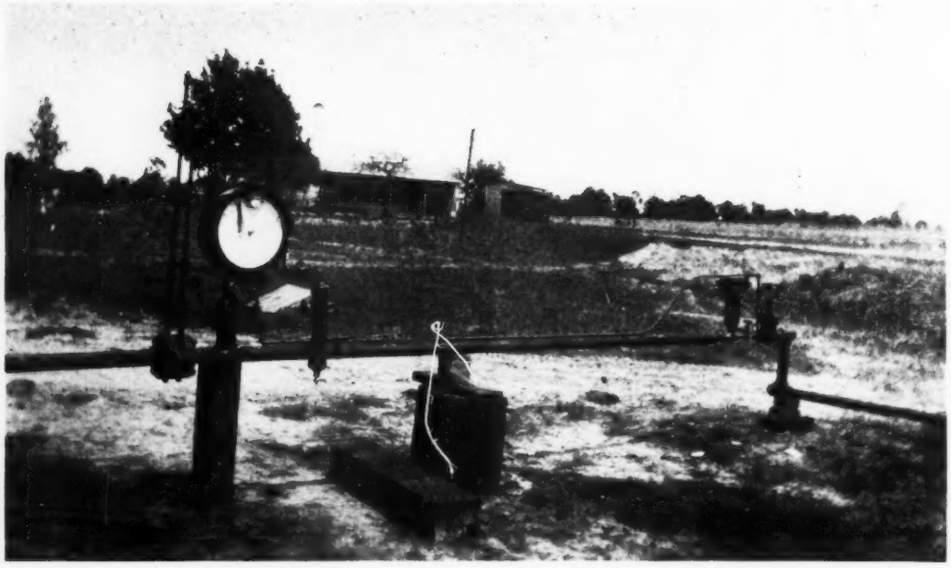
DISTRICT OFFICES

NEW YORK
CLEVELAND
PHILADELPHIA
HOUSTON
TULSA
PITTSBURGH
LOS ANGELES

Agents

F. C. RICHMOND MACHINERY CO
Salt Lake City, Utah

REEVES & SKINNER MACHINERY CO
St. Louis, Mo.

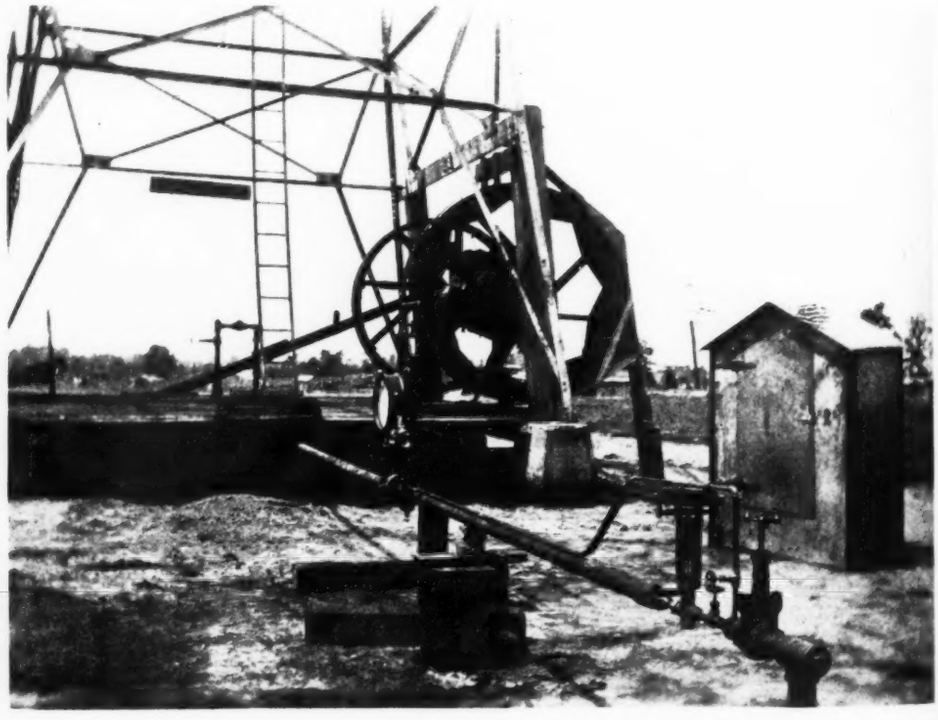


Recording orifice meter and volume control on key well.

One other notable feature pertaining to underground conditions is the variation in existing rock pressure over the field. Near the center of the field, in what was once the flush production area there is a low pressure while towards the edges of the field the pressure is much higher. Thus the field has been roughly divided into a high-pressure area and a low-pressure area (see map). An effort has been made to replenish the sand with injected dry gas in the area of low pressure, thereby decreasing automatically vacuum operations in the field. The porosity of the Blossom sand is somewhat similar to the Bartlesville sand in Oklahoma, but it has a much higher saturation.

When the repressuring project was started most of the wells were being produced under 27 to 28 inches of vacuum. This constituted a problem, as it was desired to decrease the vacuum gradually and at the same time maintain the normal rate of production. By carefully controlling fluid levels the vacuum has been removed gradually without affecting, save in a few instances, the normal rate of production. Where the production was adversely affected, it was due to the necessity of changing to small orifice plates in the key wells. This condition usually was of temporary duration and the production, when it did return to normal, was accompanied by a lowering of the gas-oil ratio. This was to be expected of course. In fact, when a high vacuum was carried on the wells, the oil was being robbed of its gas and vapors, thus causing rapid depletion of the gas in the sand. In what was originally the flush area when the field was developed observations have revealed that the effects of high vacuum have been felt for great distances in the sand, so great was the depletion of gas in this area.

The vacuum has been reduced to about 8 inches. A close check is kept on the reduction of vacuum over the field. When a well is cleaned out, it may be shut in for 24



Key well equipped with volume control for regulating the quantity of inlet gas.

What are you planning next?

Submit your hardest specification . .

You will find
that we interpret it out of a background of experience with identical or similar problems.

You will find
that we have the most modern facilities to fabricate piping for high pressures and high temperatures.

You will find
that our engineers can serve you with practical ways and means to attain unusual technical objectives.

You will find
that we think also in terms of speed, low installation expense, low maintenance, and longevity.

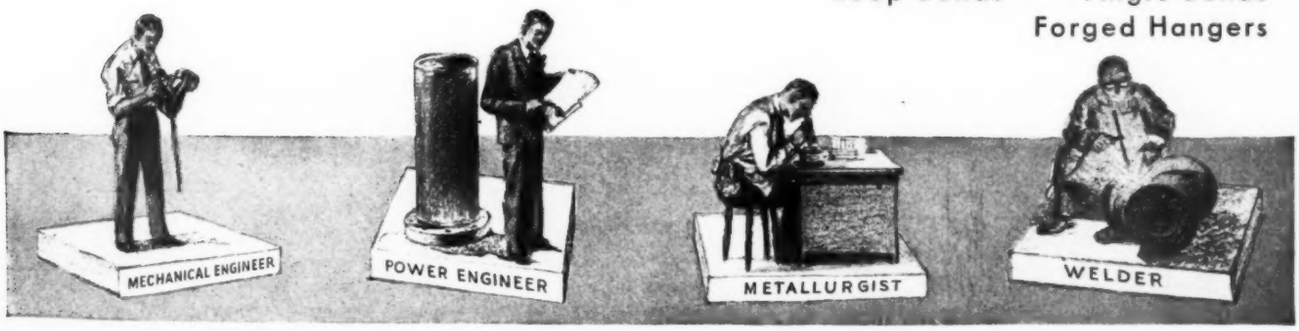
Fractionating Oil Refinery—High and low pressure steam and hot oil and water Piping by Grinnell. . . . Hangers—Special Grinnell Hangers, Supports and Clamps.

Engineers: Foster Wheeler Corporation New York, N. Y.

TRIPLE XXX PRODUCTS

High pressure, high temperature oil piping—piping for complete refinery, pumping or compressor station or simply a bend, welded header or coil.

Lap Joints—Welded Headers
Loop Bends — Angle Bends
Forged Hangers



GRINNELL COMPANY

Executive Offices: Providence, R. I.
Branches in all Principal Cities

FABRICATING AND MANUFACTURING PLANTS

Atlanta, Ga.
Auburn, R. I.
Columbia, Pa.
Providence, R. I.
Warren, Ohio

BRANCH PLANTS AND WAREHOUSES

Charlotte, N. C.
Chicago, Ill.
Cleveland, Ohio
Kearny, N. J.
Philadelphia, Pa.
St. Louis, Mo.
Oakland, Calif.
Minneapolis, Minn.
Los Angeles, Calif.
San Francisco, Calif.
Seattle, Wash.
Atlanta, Ga.
Providence, R. I.
Warren, O.
St. Paul, Minn.

BRANCH OFFICES

Tulsa, Oklahoma
Dallas, Texas
St. Louis, Mo.
Charlotte, N. C.
Atlanta, Ga.
Chicago, Ill.
St. Paul, Minn.
Cleveland, Ohio
Minneapolis, Minn.
New York, N. Y.
Philadelphia, Pa.
Pittsburgh, Pa.
Providence, R. I.
Warren, Ohio
Los Angeles
San Francisco

Offices also in all other principal cities of the United States and Canada.

When writing GRINNELL COMPANY *please mention The Petroleum Engineer*

hours so that the underground vacuum in the vicinity of the well can be accurately ascertained. Underground pressures are controlled by maintaining back pressure in the well, by fluid levels, or by maintaining a slight vacuum on the well. In the latter case, for example, an orifice plate is inserted in the line and about 5 inches vacuum held on the well side of the orifice and 27 inches on the other. There has been no trouble with by-passing in the sand. A daily check of all volumes by wells is made. In addition tests are made periodically by manometer. By this check method of observation gas-oil ratios are kept within reasonable limits.

Although it is too soon to evaluate the effect on production, it can be said that the production decline has been retarded, and the normal daily production increased over the normal figure of a year ago. There was no desire to increase the rate of production when the project was conceived. The main objective in the early life of the repressuring project has been to reduce the vacuum in the sand gradually and build up a slight reservoir pressure by the injection of dry gas into the depleted areas of the sand.

All wells, with the exception of five on a pumping power, are produced on the beam. At present the oil is produced with a total gas-oil ratio of 800 cubic feet per barrel. Before repressuring was started, the total gas-oil ratio was 250 cubic feet per barrel. The oil has increased in gravity from 34.4 degrees A. P. I. before repressuring to 35.5 degrees at the present time, at which point it is almost constant. Not only has the gravity of the oil been increased, but the sediment in pipe line runs has been reduced to an average of less than 1.2 per cent.

Flood nipples are now in use for maintaining fluid levels in all wells in the repressured area. During the last six months it has been possible to raise them on an average of from 5 to 20 feet per well. This has been instrumental in decreasing lifting costs and maintaining the rate of production.

There are four casinghead gasoline plants to which all the return gas from the wells is delivered. The residue gas from these plants is used for field boilers, engines and general lease requirements. An increase in gravity at three of the gasoline plants from 72 to 74.3 degrees A. P. I. has been obtained while the fourth plant has been running normally from 75.8 to 76.0 degrees A. P. I. without any perceptible change.

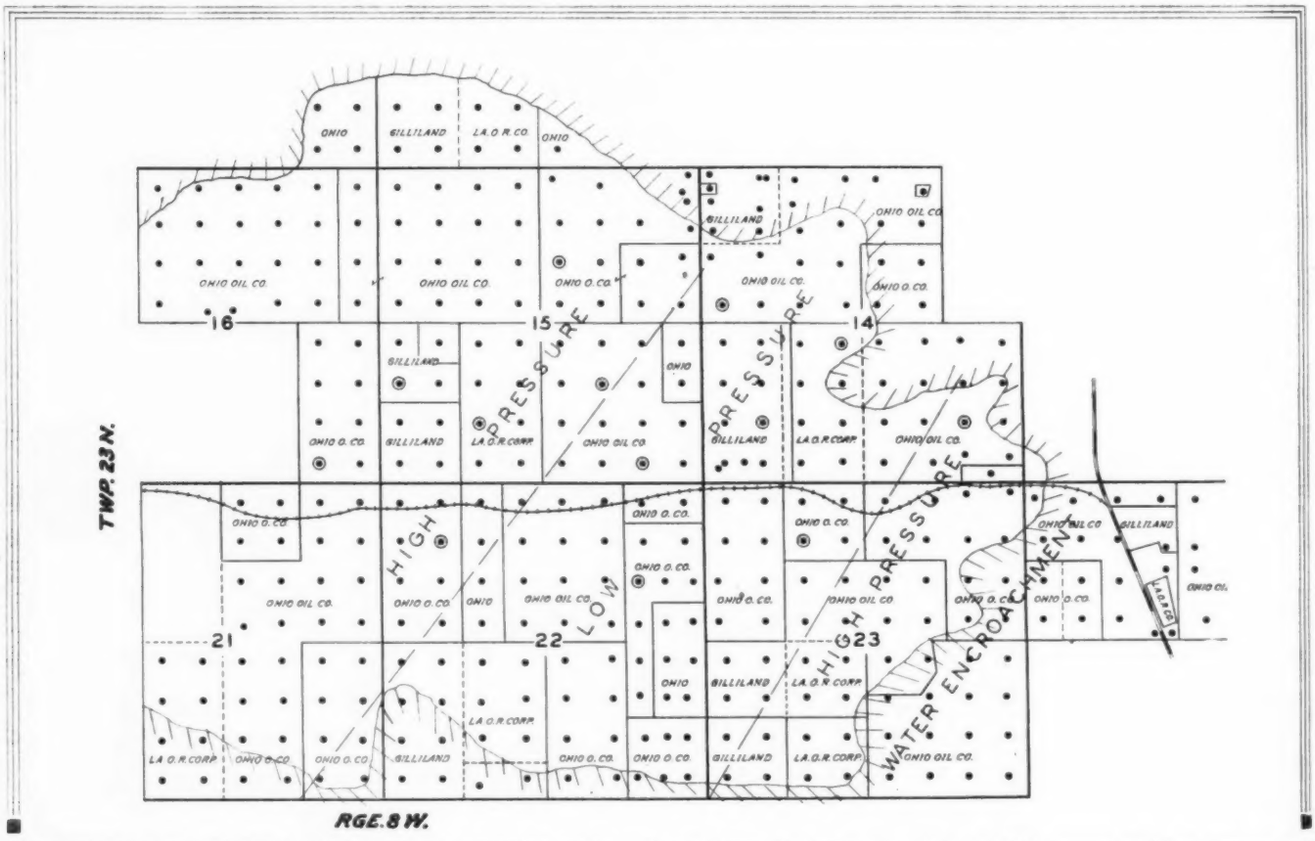
The gasoline content has dropped from 10 gallons per thousand to 6 gallons per thousand as a result of the injection of dry gas.

It is unfortunate that accurate initial rock-pressure data are not available. No readings were made when the field was brought in and estimates made vary so widely that they are of no value. An average casing string in the field consists of 88 to 125 feet of 10-inch surface pipe cemented with 10 sacks cement.

A string of 6¼ or 6⅝-inch casing is set at from 2,676 to 2,796 feet and cemented with 75 to 100 sacks cement. Practically all wells in the area being repressured have 100 to 150 feet of 4½-inch liner, the lower 20 to 50 feet of which is perforated screen pipe. In some wells trouble with the 6-inch casing necessitated landing it at 1,800 feet, and in these wells a 4½-inch casing has been run as the finishing string.

Initial production of wells in the field varied from 250 to 8,000 barrels a day. The discovery well, the Reserve Petroleum Company's Anna Taylor No. 2 in NW NW Section 14, had an initial production of 4,000 barrels. Today its daily production is one barrel. The present average daily production for the field is about 4,400 barrels.

Though still in its infancy the project has yielded results so pronounced that it is quite probable the repressuring project will be extended to include other properties on the west edge of the field.



Map showing the area included in the Haynesville repressuring project. Circles denote the key wells. Also, the high pressure and low pressure areas and the line of edge-water encroachment are indicated.

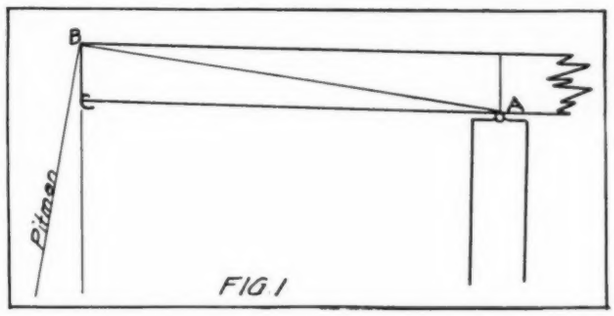
Change in

Rig Set-Up Reduces Vibration

By A. L. FABER[1]

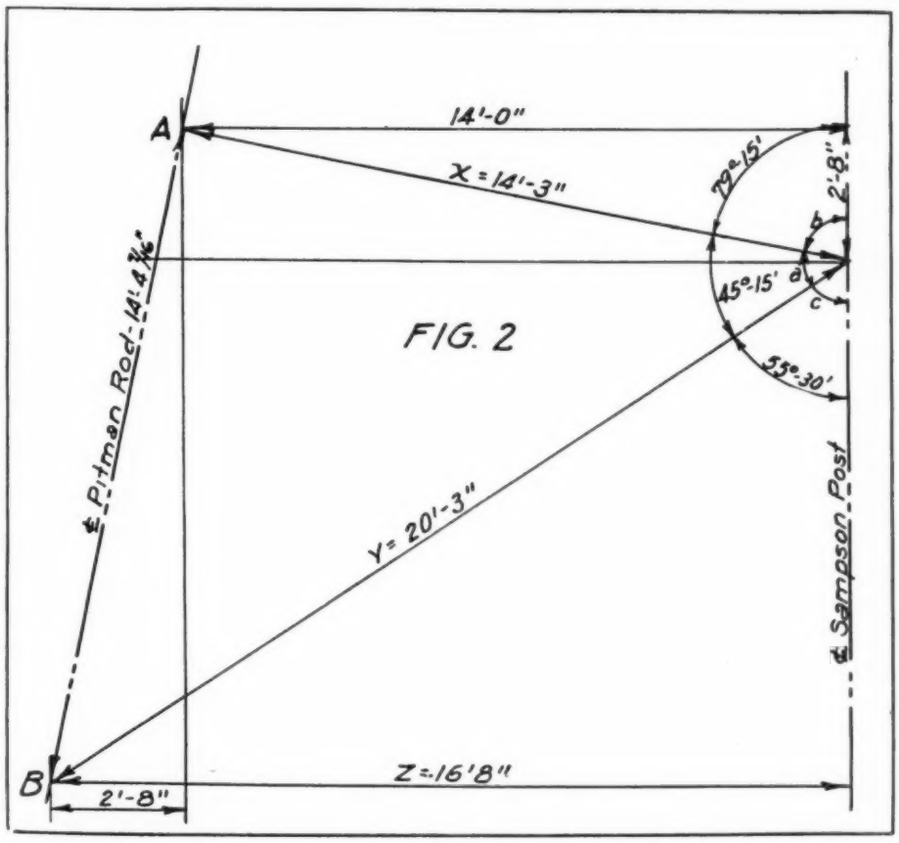
IN the Smackover field, Arkansas, tests recently made on pumping wells under actual field conditions furnish data which indicate that large economies can be secured by changing the usual mechanical set-up of rig fronts.

On a pumping well the usual method of rig set-up is to level the walking beam and make the distance between the center of the sampson post and the polished rod equal to the distance between the center of the crank and the center of the sampson post. An analysis of this rig set-up will show that, with the usual walking-beam layout, the pitman, the polished rod and the walking-beam bearing are not on the same line, therefore the application of power is at an angle which varies with the length of working centers and the size of walking beam. A vector study of forces shows that a good part of the power applied is lost in forces setting up stresses against the sampson post. This is detrimental to efficient operation in two ways; first, it results in loss of power, and second, vibration and shock on the rig are increased. Referring to Fig. 1, it will be seen that the actual operating line is A-B, and therefore the rig set-up must be made with reference to the line A-B, instead of the line A-C. In the usual rig layout the line A-C is chosen as a reference line with the result that increased rig stresses are set up because of the angularity of power application.



A graphic study[2] of rig set-up was made, with the purpose of investigating why better operation was obtained under counter-clockwise rotation than under clockwise rotation. Plotted vector forces indicated that the rig set-up and the angularity were the main responsible factors to which could be attributed the difference in operation; however, a theoretical study of an oil field problem is not enough, so it was decided to check the results by tests on an actual installation. Fig. 2 shows the graphic layout made for an actual installation. It will be noted that the center of crank was found to come 32 inches farther from the center line of the sampson post than in the usual set-up. In short, the distance from the sampson-post center line to the center of crank was 16 feet 8 inches, and the distance between the polished rod and the center of the sampson post was 14 feet. For the field set-up slight changes were required in the pitman length.

It was found that the best way to make this set-up was to have the crank on the quarter with the walking-beam level. The length of the pitman is then increased to make its length sufficient to have the crank on a line at right angles to line A-B. This made the pitman length 14 feet 9 inches in the layout as shown in Fig. 2. It was in this way that the well layout was prepared for the test. In order to facilitate the changing of the crank center a wooden foundation was put in. This consisted of pieces of an old wooden walking-beam, two pieces being laid crosswise and two pieces lengthwise. These were bolted together at four places. No stakes were set to hold the foundation in place. Holes



[1] Acknowledgment is made to Mr. Todd and Mr. Johnson of the Simms Oil Company, and to Mr. Lang of the Marine Oil Company, for their co-operation and help.

[2] See "Rig Set-Up and Its Effect in Counterbalancing," by A. L. Faber in The Petroleum Engineer, July, 1930.

were drilled to set a mechanical unit in the usual position and with the crank center 32 inches back. The general arrangement is shown in photograph, Fig. 3.

Complete tests were run in both positions and power curves taken with the well operating with clockwise and with counter-clockwise rotation of the crank. The power curves are shown in Figures 4, 5, 6 and 7. The method of procedure was to counterbalance the well in each position and then allow it to operate for twenty-four hours before the power curves and the necessary data shown were taken. The rig dimensions were as follows:

Sampson post, height, 15 feet 3 inches.

Walking-beam, 28 feet.

Working center, 14 feet.

The well was operated by a Columbia Type Lufkin Unit driven by a 10 H. P., 1200 R. P. M. squirrel-cage motor through a V-belt drive. Operation was at 23—48-inch strokes per minute, with 2½-inch tubing, ⅝-inch rods, and plain working barrel, pumping from approximately 2,200 feet depth.

Fig. 4 shows the power curve in the new position as per Fig. 2. It is interesting to note that the power peak on the rods went to 7.0 K. W. while the counterbalance peak hit 7.5 K. W. This was as close as the well could be counterbalanced. The power curve also hit zero during the dropping of the rods. Power consumption was 6.3 K. W. H. an hour. The lack of vibration during this operation was most noticeable as there was no movement of the portable foundation or the unit.

Fig. 5 shows the power curves with crank rotating counter-clockwise. It is to be noted that distortion took place, the rod peak increasing, but the power still going to zero on the downstroke. There was a slight vibration in the unit and the foundation timbers. This distortion is caused by the long pitman and comparatively short length

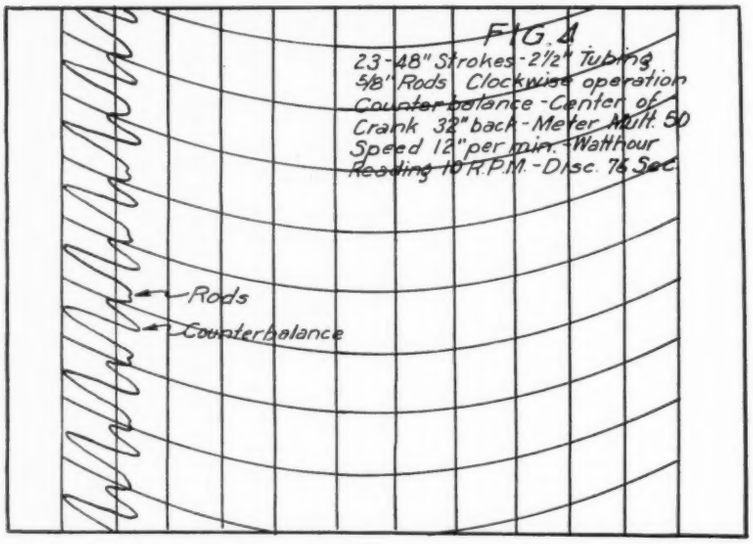


Fig. 4

of polished rod stroke. The power used was 7.8 K. W. H. per hour. No attempt was made to change the counterbalance for this operation as the main object was to get the best operation with the crank rotating clockwise or forward. On the longer strokes this distortion does not occur.

Fig. 6 shows the power curve for clockwise crank rotation with the well set-up in the usual position, that is, the distance between the crank center and the sampson post center line 14 feet, and the distance between polished rod and the sampson post center line 14 feet. It will be noted that the rod peak hit 10 K. W. and counterbalance peak 9 K. W., while the lowest power value on the downstroke was 1.25 K. W. The power consumption was 6.6 K. W. H. per hour. Vibration was very marked and the timbers moved up and down. It is to be noted that the weights had to be moved only some two inches farther on the crank to get the well counterbalanced. We believe that it takes from 10 to 20 per cent more counterbalance effect in this position than in the new position.

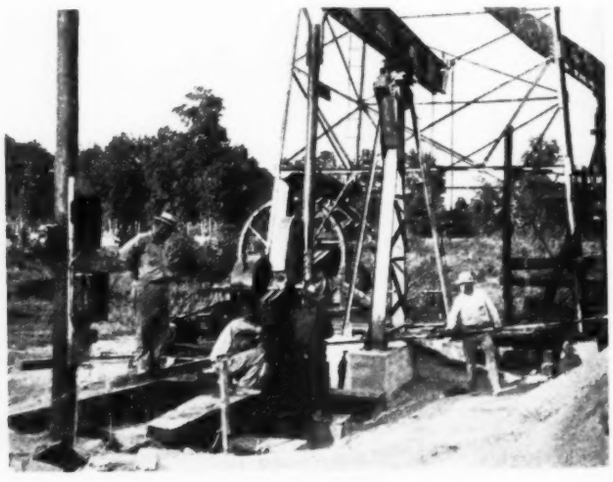
Fig. 7 shows the power curve in the usual position with the crank operating counter-clockwise. The K. W. H. per hour is the same value as before; namely, 6.6. The vibration was about the same as in clockwise operation, which again seems to show that there is no saving in power on counterbalanced wells in the usual position between counter-clockwise and clockwise operation.

The length of stroke was measured in both set-ups and it was two per cent shorter in the usual set-up than in the new set-up.

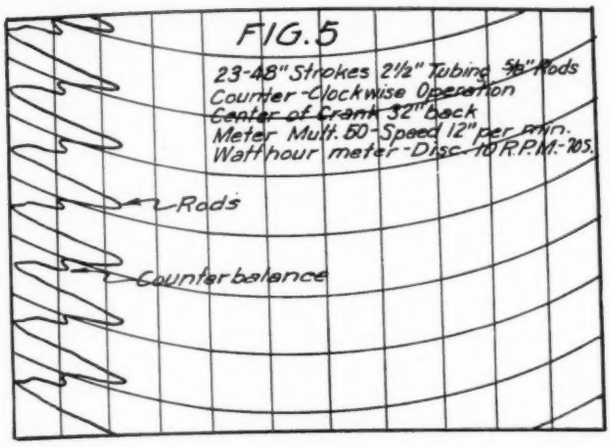
The results of this test show that the new set-up:

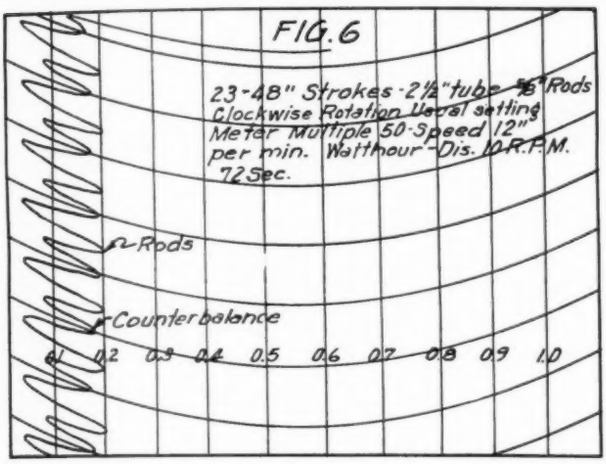
(1) Gives much smoother operation.
(2) Operates with 5 per cent less power input.
(3) Gives a 2 per cent longer stroke.
(4) Has a 25 per cent less power peak on the basis of the usual set-up; namely, 7.5 K. W. as compared with 10 K. W.

Fig. 3—Type of foundation on which mechanical unit was set for tests.



Adjusting the counterbalance.





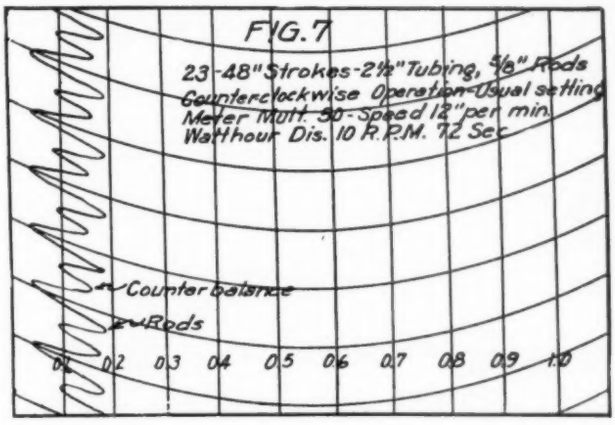


FIG. 7
23-48" Strokes-2½" Tubing, ⅝" Rods
Counterclockwise Operation-Usual setting
Meter Mult. 50-Speed 12" per min.
Watthour Dis. 10 R.P.M. 72 Sec.
Counterbalance
Rods
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

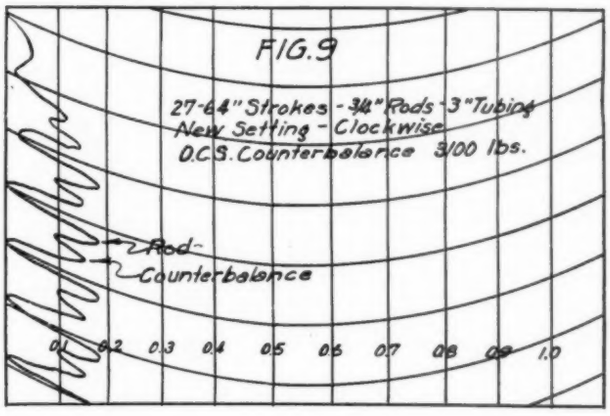


FIG. 9
27-64" Strokes - ¾" Rods - 3" Tubing
New Setting - Clockwise
O.C.S. Counterbalance 3100 lbs.
Rod-
Counterbalance
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

It is reasonable to conclude that power peaks are a direct indication of stress peaks. Evidence of this is seen in the smoother running of the unit in the new position.

As a result of the test run, new rig set-ups were made on heavier wells.

Fig. 8 shows the graphic layout of the rig dimensions, which were as follows:

Sampson post height, 15 feet 7 inches.
Walking-beam, 25 feet.
Working center, 12 feet 6 inches.

The power curves in Figures 9, 10, 11 and 12 are those obtained in the operation of two comparable wells. One on the old setting and the other on the new setting. The data on these wells are as follows: 27—64-inch strokes, ¾-inch rods, 3-inch tubing, O. C. S. unit with counterbalance driven by a 35/75 G. E. motor. It is to be noted that with the new setting, 3,100 pounds of counterbalance weight was used, giving a slightly over-counterbalanced condition while on the old setting it took 3,800 pounds to counterbalance the well.

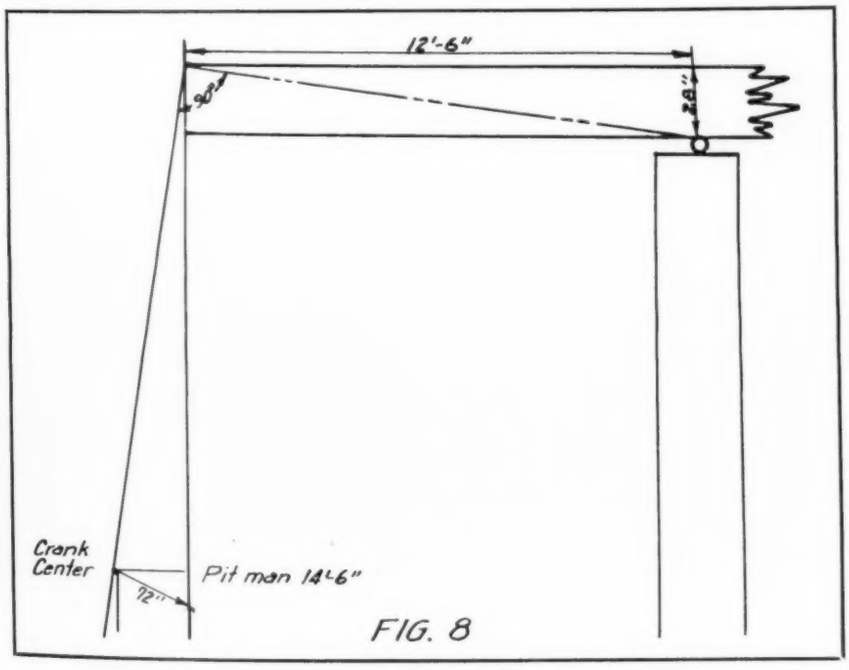


FIG. 8

Fig. 9 shows power curves with the new setting operating clockwise. It is to be noted that the power reaches zero on the downstroke and that the rod peak value is 30 K. W. with a counterbalance peak of 36 K. W.

Fig. 10 shows the curve obtained with the well operating backwards. It is to be noted that the curve is approximately the same as that of Fig. 8 with no distortion.

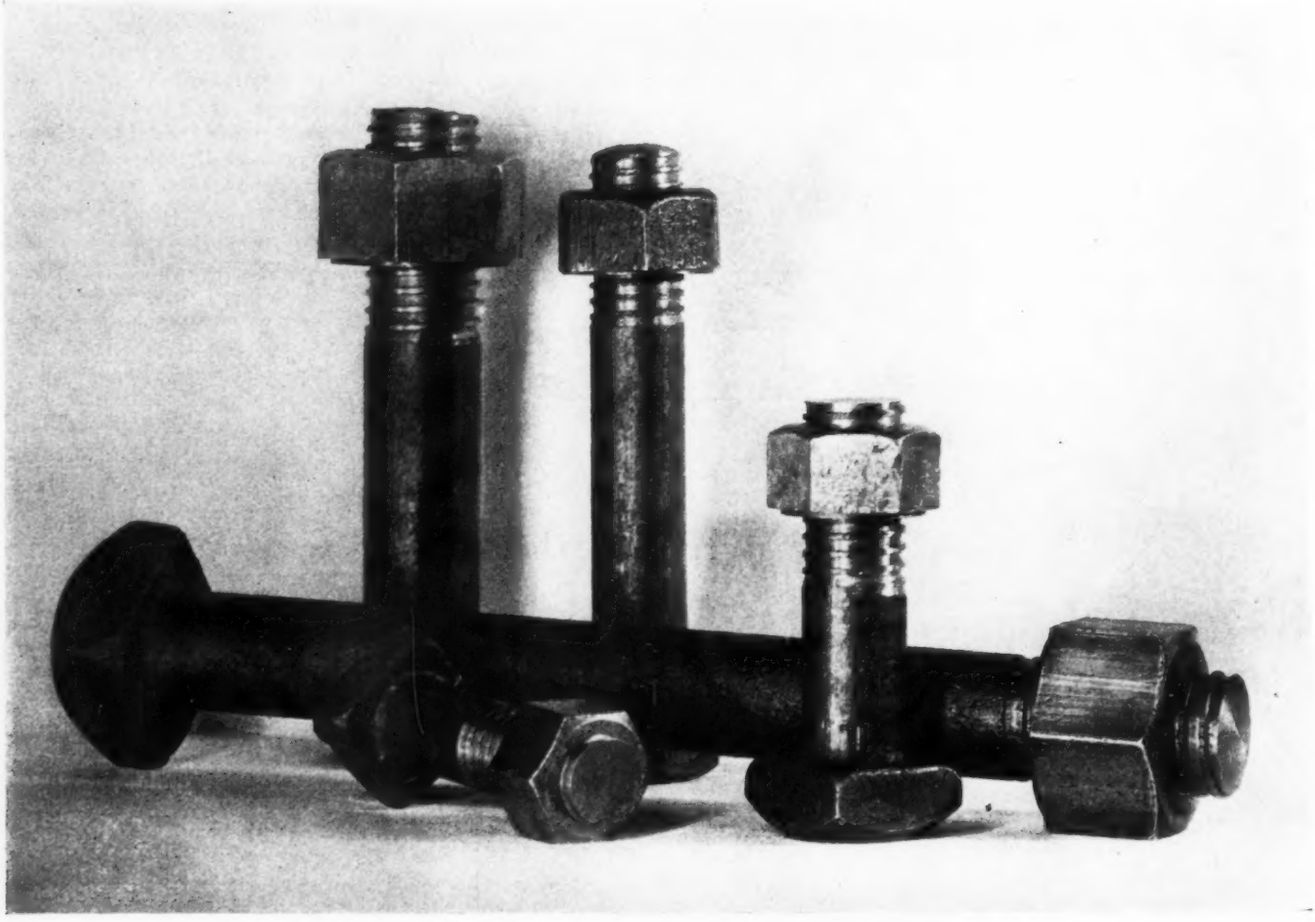
Fig. 11 shows power curves on the usual set-up. It will be noted the rod peak value is 41 K. W., while the counterbalance peak reaches 38 K. W.

Fig. 12 shows the curve obtained with counter-clockwise operation on the usual

THE SELF-LOCKING

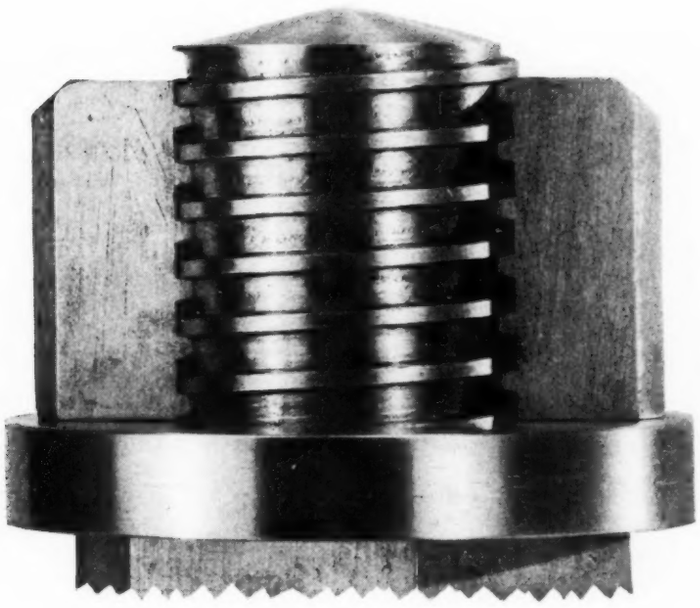
DESIGNED TO END FOR ALL TIME THE PROBLEM OF LOOSE FASTENINGS ON EQUIPMENT SUBJECT TO VIBRATION AND SHOCK—

HOLDS ABSOLUTELY TIGHT UNDER ALL SERVICE CONDITIONS WITHOUT LOCK WASHERS, JAM NUTS OR OTHER LOCKING DEVICES—IS UNINJURED BY THE LOCKING ACTION, THEREFORE MAY BE USED REPEATEDLY—REDUCES ASSEMBLY AND MAINTENANCE COSTS



When writing DARDELET THREADLOCK CORPORATION *please mention The Petroleum Engineer*

DARDELET SCREW THREAD



THE locked position of the Dardelet Thread, shown above, is similar to that of a taper pin powerfully forced with a screwing movement into a tapered hole. The locking friction of the tapered faces combined with the small friction of the active abutment faces is always greater than any friction that can exist between the surface of the nut and the surface of the work. No accidental loosening of the nut is possible—yet when desired it can be readily adjusted or removed with the wrench without injury to the thread.

DARDELET THREADED BOLTS AND NUTS WILL BE ON DISPLAY

INTERNATIONAL PETROLEUM EXPOSITION

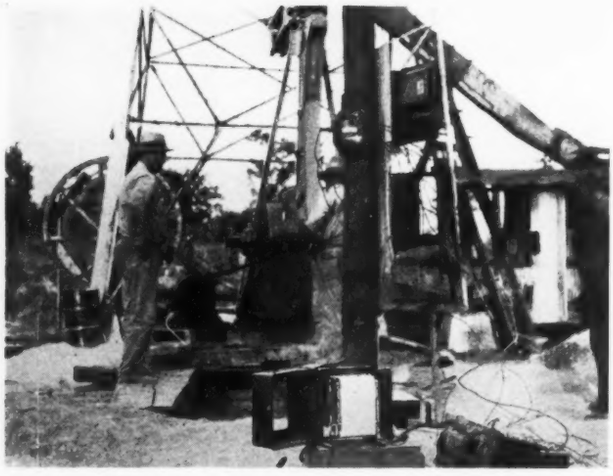
BETHLEHEM STEEL COMPANY

BOOTHS 130-133, TEXAS BUILDING

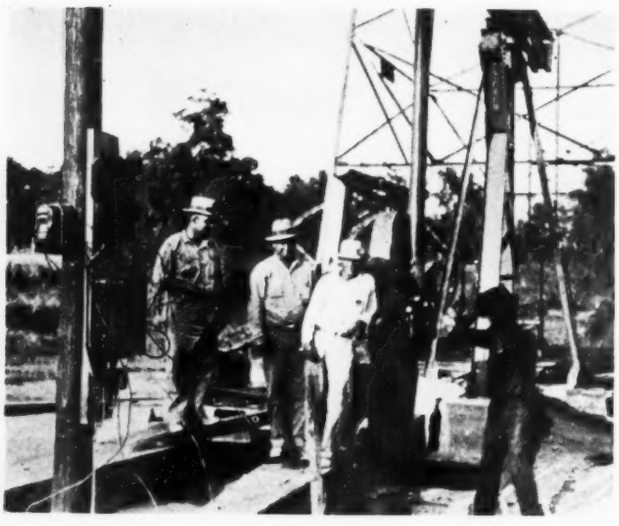
DARDELET THREADLOCK CORPORATION REPRESENTATIVES WILL BE IN ATTENDANCE

The Dardelet Self-Locking Screw Thread is protected by patents and is manufactured in the United States under license from the Dardelet Threadlock Corporation.

DARDELET THREADLOCK CORPORATION **120 BROADWAY, NEW YORK, N. Y.**



Obtaining the power input curves—note line chart recorder in foreground.



One of the wells on which tests were made—Smackover field, Arkansas.

setting. The rod peak hits 40 K. W. and counterbalance peak reaches 37 K. W.

It is to be noted that the new setting is operating on 600 pounds less counterbalance weight and a little less flywheel effect and is over-counterbalanced. The results on this comparison check with the lighter well, as the peak is cut down 25 per cent the length of stroke is increased 2.5 per cent and the power saving shown is 8 per cent. One very noticeable feature is the smoothness of the rig operation.

It may be explained that close counterbalancing on the new set-up was not possible because of the danger of sanding up the well. The operation, however, was satisfactory, although the counterbalance peak could have been brought down without increasing the rod peak. A check of the well was made by listening to the standing valve open and close. This was done with a blood-pressure type of medical stethoscope. It was noted by observation that there seemed to be no loss of stroke in the new setting and very little on the usual setting where the well was counterbalanced.

From the results obtained it is felt that the setting of rigs should be changed on restandardization of new wells to the new rig setting, or, in other words, to a setting that will put the crank center on a line at right angles to the actual operating arm of the walking-beam. Using this setting, an enormous saving can be made primarily in rig and rod maintenance by cutting down shock stresses and, secondarily, by a substantial reduction in power requirements.

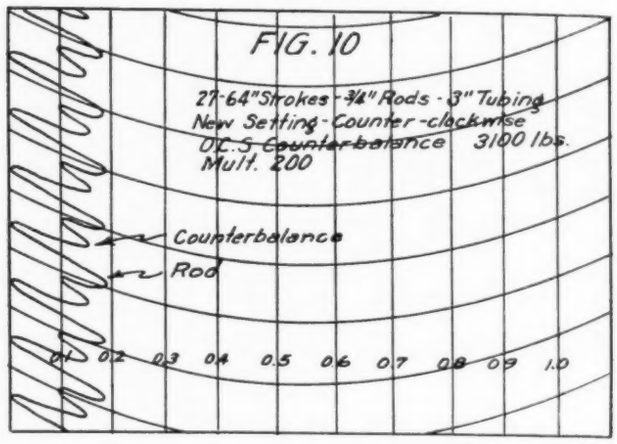


FIG. 10
27-64" Strokes - 3/4" Rods - 3" Tubing
New Setting - Counter-clockwise
O.C.S. Counterbalance 3100 lbs.
Mult. 200
Counterbalance
Rod
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

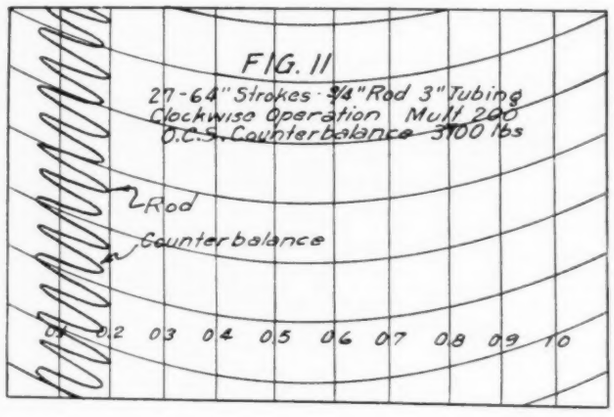


FIG. 11
27-64" Strokes - 3/4" Rod 3" Tubing
Clockwise Operation Mult 200
O.C.S. Counterbalance 3100 lbs
Rod
Counterbalance
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

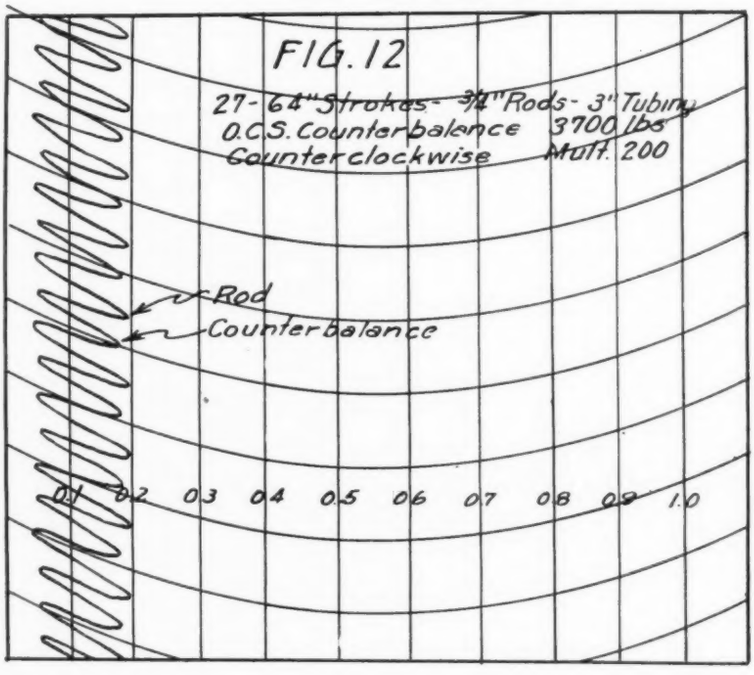
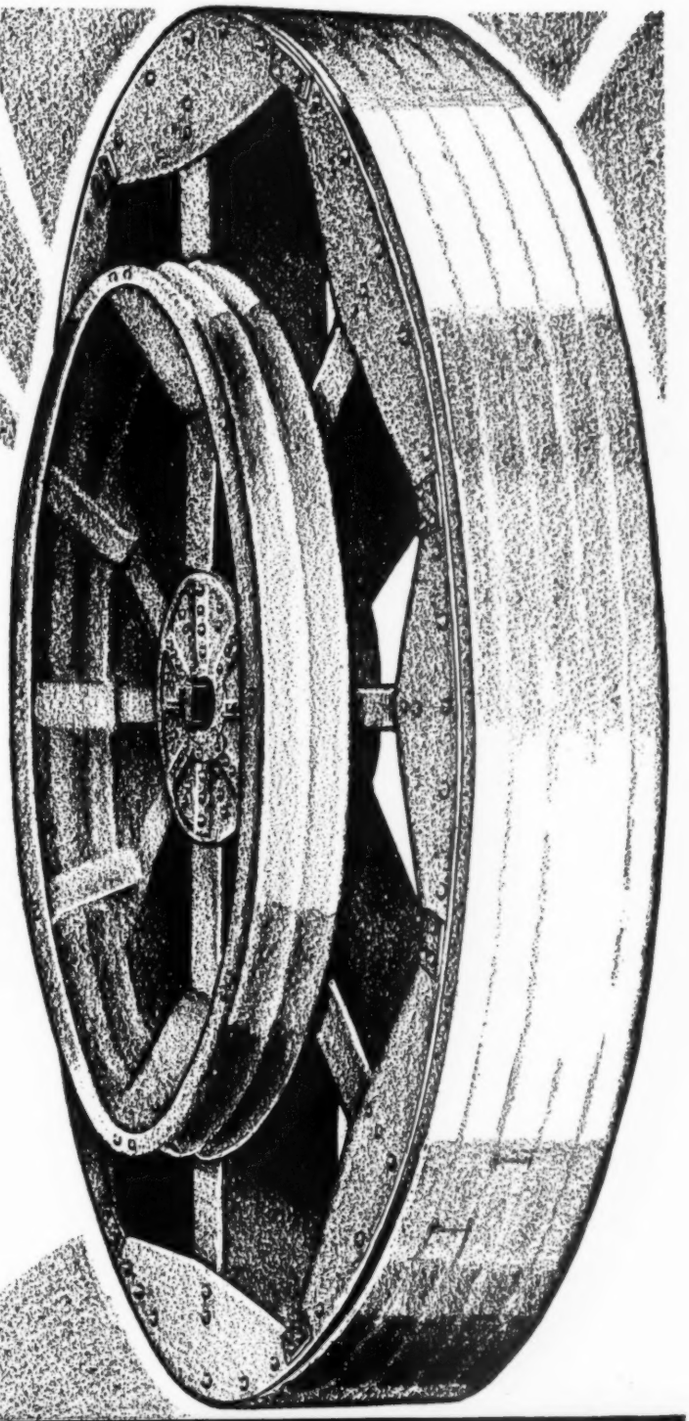


FIG. 12
27-64" Strokes - 3/4" Rods - 3" Tubing
O.C.S. Counterbalance 3700 lbs
Counterclockwise Mult. 200
Rod
Counterbalance
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0



Moore

BAND WHEEL

AS GOOD AS THE CHAMPION DERRICK

The full rigid strength which the proper use of steel will give is built into this wheel at the plant, and it is shipped in one piece ready to be mounted on the shaft. It has steel plate rims and rolled steel channel spokes with heavy reinforcement at the flange. The latter is of one piece in heavy duty wheels. There are no bolts in the flange, machine driven rivets through spokes and angle reinforcements carrying the heavy loads at this point. One-inch wood cants are used.

Moore Tug Rim

The tug rim, which is part of the above wheel, also gives long, economical service when used on wooden band wheels. The Moore rim is of one piece, rolled steel with double V groove tug. Heavy plate brackets are electrically welded to the rim. Standard diameter is 7'.

Moore

ALL STEEL RIG EQUIPMENT

LEE C. MOORE AND COMPANY, INC.
PITTSBURGH Established 1907 TULSA
New York Offices: Oilfield Equipment Company, 30 Church Street, New York, N. Y.
DALLAS, TEXAS WICHITA, KANSAS CASPER, WYO.
SHREVEPORT, LA. HOUSTON, TEXAS
Stocks in All Principal Fields

When writing LEE C. MOORE & CO., INC. *please mention The Petroleum Engineer*

South Plains Plant Treats Panhandle Gas

THE Amarillo gasoline plant of the South Plains Pipeline Company is located about ten miles north of this city in the Texas panhandle. All of the gas sold by the company in this territory, showing any gasoline content, is processed in this plant. The average gasoline content of the gas to the plant is approximately 0.3 gallon per thousand cubic feet. Although the capacity of the plant is 30 million cubic feet per day, the load varies with the quantity of gas sold by the company, consequently the load in the cold winter months is much greater than in the summer time.

The gas from the field passes through two high pressure bubble type absorbers under 300 pounds working pressure, and the vapors are absorbed with mineral seal oil.

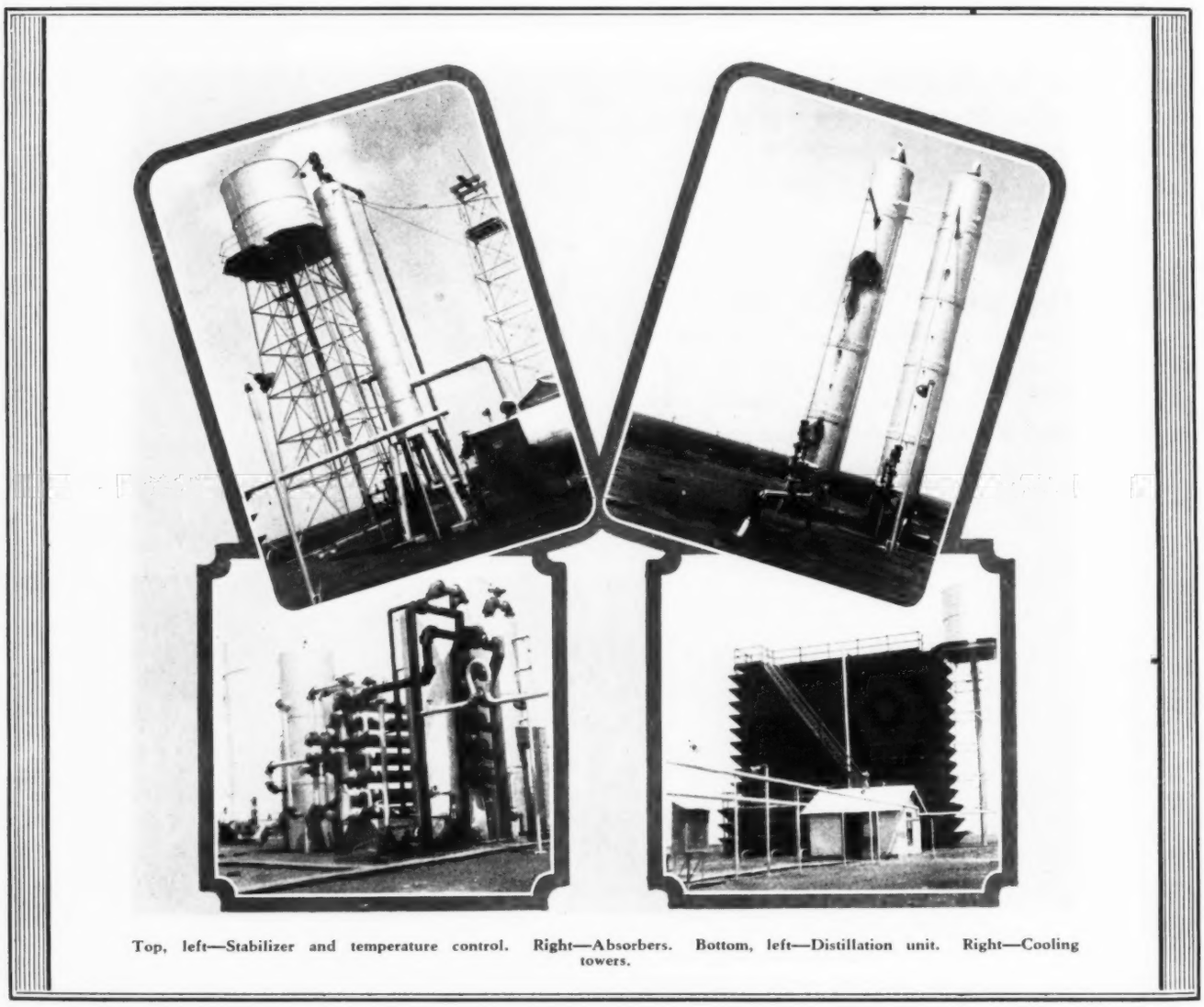
The fat oil is distilled in a modern distillation unit equipped with heat exchangers as shown in the illustration.

All of the gasoline made in the plant is stabilized to grade AA. This unit is operated under 15 pounds per square inch pressure. Automatic temperature and pressure control instruments are installed on the stabilizer and distillation unit. The finished gasoline usually passes the doctor and corrosion tests without any chemical treatment.

Water for the cooling coils and boilers is obtained from two wells. In order to economize on the water consumed in the plant all of the steam is condensed and used for make-up water to the boilers. Steam for the plant is generated by two water tubular boilers each rated at 125 horse power. They are fired with stripped gas.

All of the electrical power used is generated at the plant. The electrical generator is driven with a gas engine.

A chemical testing laboratory is maintained at the plant for testing the raw and finished products.



Top, left—Stabilizer and temperature control. Right—Absorbers. Bottom, left—Distillation unit. Right—Cooling towers.

Soil Survey *of the* Quinton Natural Gas Corporation Line

By **ROY PARKER**, *Chemist, Quinton Natural Gas Corporation*

WHEN the proposed plans for a 16-inch gas line extending from the Quinton (Okla.) gas field to markets some seventy or eighty miles distant had been accepted and the detailed survey begun, a pipe-coating program had to be planned. In considering the laying of a pipe line and its protection against corrosion, the need of knowing in advance the corrosiveness of the soil is apparent, because it is important to know how to distribute that protection. Pipe line companies and operators have recognized that the practice of coating pipe is an economic problem and, after much work and expense, have proven that the practice of varying the kind and amount of protection along different sections of a line is economically sound. One company has found it profitable to apply a two-inch bitumen coating on certain sections of its lines where the forces of corrosion are very active. It is very important, therefore, to have a means of identifying a corrosive and a non-corrosive soil. On long lines, the kind of protection required will vary according to the character of the soil.

The present-day trend in pipe line construction, once a line is proposed and plans accepted, is to finish the job as quickly as possible, still exercising the maximum amount of engineering care and thought to the project. This being the case, it necessitates the various departments to work with dispatch. In our department, where the soil surveys are completed, we must use some method or combination of methods that are rapid, reliable and the cost not prohibitive. There still exist many expert opinions as to just what the process of corrosion is, and many theories as to the principal causes, no one of which explains every phase. It has been shown in tests and is generally understood to be an electro-chemical process. The rapidity with which the corrosion proceeds varies with the resistance of the soil, moisture content, collodiol content, etc. The method and procedures used by this company were adopted after no small amount of work, together with much experimentation, and they seem to agree with the general consensus of opinion. Soil surveys were made on replacement lines and the soil values assigned various sections of the right-of-way confirmed the condition of the pipe when ditch was opened and pipe exposed. In one instance where pipe had been in the ground twelve years, and a gram index loss was .2, no replacement was necessary in this area. This method is now in use by other large oil and gas companies. It appeared in the March issue of the *Western Gas Magazine*.[1]

The procedure as used by this company is as follows:

Select a capable man to collect the samples, with instructions to walk the right-of-way with the surveying party and collect samples every half mile, or closer if there is a visible change in soil texture. Notes are made as to topog-

[1] Soil Survey on a Large Distribution System (G. Corfield).

Top to bottom—Line traversing rough country. Applying hot coating. Lining up and making joints.

Top to bottom—Backfilling with modern equipment. Heating coating in field pots. Stringing and ditching.

raphy, local drainage conditions, oil wells near right-of-way—in fact, any condition that might affect the soil in that vicinity. All data and samples are identified by stake number. The soil samples are taken with a 2-inch auger at pipe depth, packed in a one-point self-sealing fruit jar and sent to the laboratory. The test nipple used is a 4-inch length of ¾-inch standard mild steel which has been machined, numbered, cleaned with gasoline and dried. A 4-inch length of copper wire soldered on the numbered end serves as the connection. The test nipple is then weighed to the second decimal in grams. A rubber stopper, size 8, is inserted in the unnumbered end to serve as an insulator. This nipple is placed with the connection at top, in a one-pint paint can (friction top). The soil sample is removed from jar, sifted to remove stones and insure uniform size. The sample is then mixed with enough air-saturated distilled water to bring about a visible saturation, and placed around the test nipple. A 6-volt wet battery for each six cans is connected from nipples to the can; the nipples are positive. By using a 6-volt battery the loss in grams is large enough when compared with the weight of the nipple (175 grams) so that accuracy is not sacrificed either in weighing or potential corrosion efficiency. No current density data are collected during the test, but these potentials have been measured and come within the range of actual conditions. The potential is left on for 24 hours, then disconnected, nipples removed, washed, scrubbed, dried and weighed. The gram loss in weight of the nipple is considered proportional to the maximum potential corrosiveness and is used as the index. This index will vary, but arbitrary classification gives the soil the following rating:

Loss of less than one gram—Good.
Loss of one gram to 1.99 grams—Fair.
Loss of 1.99 grams to 2.99 grams—Bad.
Loss of over 2.99 grams—Very Bad.

These values are obtained as the survey progresses, and when a low resisting soil is found the sample man is instructed to collect samples on each side of this location. This enables us to locate by stake number the extent of this low resisting area. We then have the conductiveness of the soil, but should make an analytical survey to determine the nature of the salts in these low resisting areas. A high salt content does not necessarily signify corrosiveness. The following plan is submitted for the chemical analysis, which may be used to further substantiate the results of the foregoing tests:

Analytical Plan for Soils

Samplings:

Twenty (20) ounces of the sample, without crushing, is dried in the incubator to constant weight; the loss in weight equals moisture. The dried sample is ground to pass 100 mesh; two portions of ½ gramme each taken.

Place one ½-gram portion in a casserole. Moisten with distilled water, then add 15 c.c. of nitric acid, saturate with chlorate of potash, and carefully evaporate to soft dryness; add 5 c.c. of concentrated HCl. Evaporate to dryness and repeat with 5 c.c. more HCl. When cool, take up in 30 c.c. of dilute HCl (1—1), boil for a few minutes and filter into a 250 c.c. beaker. Wash the residue on the filter four times with hot distilled water; dilute the filtrate in the beaker to about 150 c.c. and heat to boiling; then add drop

by drop a 10 per cent solution of barium chloride until a precipitate no longer appears; then add 2 c.c. in excess and boil for 30 minutes. Remove from the heat and let stand until clear. It is well for it to stand over night. Then filter, wash several times with hot distilled water, dry, ignite and weigh as barium sulphate, from which the total sulphur may be calculated.

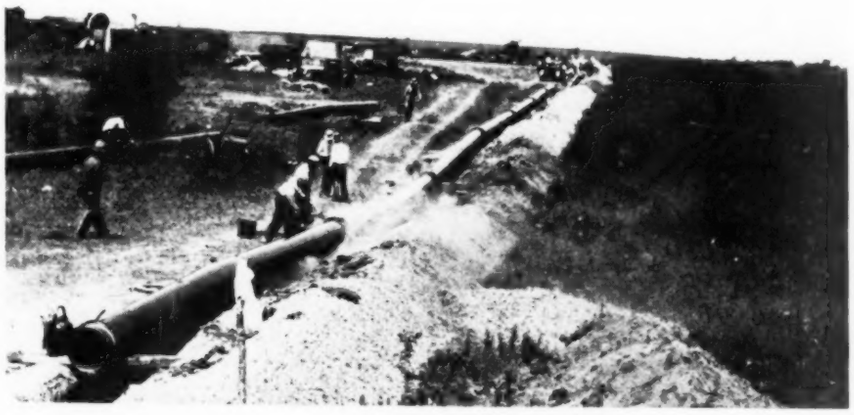
The second portion (½ gramme) is put into a crucible and strongly heated to a high heat, dried in dessicator and weighed. The loss in weight is the loss by ignition—i. e., combined water, organic matter, CO_2 and part of the sulphur, some possibly remaining as sulphates. All water soluble sulphates will be determined in the water later.

Insoluble — Fe_2O_3 + Al_2O_3 — CaO — MgO:

The ignited portion is then placed in a casserole, twice evaporated to dryness with 15 c.c. of concentrated HCl, then taken up with 15 c.c. concentrated HCl and 30 c.c. of distilled water; boiled for a few minutes, settled and filtered into a 250 c.c. beaker, well washed with hot distilled water, the residue on the filter paper dried, ignited and weighed as insoluble SiO_2.

To the filtrate in the 250 c.c. beaker add an excess of NH_4OH and boil until neutral; let settle and filter into a 400 c.c. beaker. The residue on the filter is well washed with distilled hot water, ignited and weighed as Fe_2O_3 + Al_2O_3, which may be fused and determined separately if desired.

The filtrate from the iron and alumina in the 400 c.c. beaker is made strong with ammonia, heated to boiling and an excess of a boiling solution of ammonium-oxalate added and let boil for a few minutes. Settle until clear, then filter into a 400 c.c. beaker and the filter well washed with hot distilled water; the filter and residue are then dried, ignited to a white head, cooled in dessicator and weighed as CaO.



Lowering and painting.

The filtrate from the CaO is boiled down to about 100 c.c.; a saturated solution of sodium ammonium phosphate is slowly added as long as a precipitate forms, 5 c.c. in any event, stirring vigorously. Then add 50 c.c. of strong ammonia, still stirring, and let it stand over night. Filter, wash well with cold distilled water made alkaline with ammonia; dry the filter, ignite and weigh as $Mg_2P_2O_7$, from which the MgO may be calculated.

Procedure for Leaching Soils and Analysis of Water:

Eight ounces of the soil sample are mixed with 400 c.c. of boiled distilled water in a small bottle; the contents should be thoroughly agitated at least ten times a day for six days. On the seventh day, note all the physical characteristics—i. e., the approximate amounts of soil, sand and gravel, which is reported in part as per cent of silt; then filter into a bottle and cork.

Portions of the solution are subsequently taken as follows:

100 c.c. for Total Solids, Organic Matter, Insoluble Matter, Iron and Alumina, Calcium, Magnesium, Sodium and Potassium.

50 c.c. for Sulphate.

100 c.c. for Alkalinity and Chlorine.

50 c.c. for Hydrogen I on Concentration.

Total Solids:

Pipette off 100 c.c. and evaporate to dryness in a small beaker and weigh; the difference in weight is the total amount of solids in the water.

Organic Matter:

Ignite and weigh. Loss is due to organic matter.

Insoluble (SiO_2):

Take up in 5 c.c. (10 c.c. if there is a large amount of salts) and evaporate to dryness; heat at about 150 degrees for several minutes, then take with 5 c.c. of HCl and 35 c.c. of water; boil until all soluble salts are dissolved; filter, ignite and weigh as SiO_2. Iron plus Alumina (Al_2O_3 + Fe_2O_3):

To the filtrate add 3 to 5 c.c. of strong HNO_3 and heat to boiling; add 10 c.c. of strong NH_4OH (or neutralize and add 5 c.c. in excess). Boil until the odor of ammonia is faint; filter, ignite and weigh as Fe_2O_3 + Al_2O_3.

Calcium:

To the boiling filtrate add 10 to 15 c.c. of boiling solution of equal parts water and saturated ammonium oxalate, and let stand hot for at least twenty minutes; filter, ignite and weigh as CaO.

Magnesium (Mg):

To the boiling filtrate add 5 c.c. of sodium ammonium phosphate solution, cool a little and add 25 to 35 c.c. of strong NH_4OH and let stand 12 hours; filter and wash with diluted ammonia water, ignite and weigh as $Mg_2P_2O_7$.

Sodium Plus Potassium (Na+K):

The amount reported under this heading is the difference between the amount reported for total solids and the sum of all other factors determined by this analysis. It is almost entirely sodium and potassium and is reported as such.

Sulphate (SO_4):

To a 50 c.c. portion add 3 c.c. HCl and boil; then add 5 c.c. of 10 per cent barium chloride solution; boil for at least five minutes and let stand 12 hours; filter, ignite and weigh as $BaSO_4$.

Alkalinity:

With Phenolphthalein: Add 4 drops of phenolphthalein indicator to 100 c.c. sample in a white porcelain casserole. If the solution becomes colored, hydroxide, or normal carbonate, is present. Add N/.02 H_2SO_4 until coloration disappears. Multiply number of c.c. used by 10 if 100 c.c. water has been used, and result is phenolphthalein alkalinity in parts per million of calcium carbonate.

Example: 10 c.c. used in decolorizing 100 c.c. of water. Phenolphthalein alkalinity equals 10×10 or 100 parts per million in terms of calcium carbonate.

With Methyl Orange: Add 2 drops indicator to 100 c.c. sample or to solution to which phenolphthalein has been added in white porcelain casserole. If solution becomes yellow, hydroxide, normal carbonate or bicarbonate is present. Add N/.02 H_2SO_4 until faintest pink coloring appears, or rather until yellow has disappeared entirely. Multiply number of c.c. used in titrator by 10 if 100 c.c. was used, and this gives the methyl orange alkalinity in parts per million of calcium carbonate. Example: 40 c.c. used in neutralizing methyl orange alkalinity equals 40×10 or 400 parts per million of calcium carbonate.

Carbonate (CO_3):

Carbonate is present if phenolphthalein alkalinity is greater than zero but less than methyl orange alkalinity. If phenolphthalein alkalinity is exactly equal to one-half methyl orange, then it is due entirely to normal carbonate. If phenolphthalein is less than one-half methyl orange, normal carbonate in terms of calcium carbonate is equal to two times phenolphthalein alkalinity.

Bicarbonate (HCO_3):

Bicarbonate is present if phenolphthalein alkalinity is less than one-half methyl orange alkalinity; the methyl orange alkalinity is due entirely to bicarbonate if there is no phenolphthalein alkalinity. Bicarbonate alkalinity in terms of calcium carbonate is equal to methyl orange minus twice the phenolphthalein alkalinity.

Hydroxide (OH):

Hydroxide is present if alkalinity to phenolphthalein is greater than one-half alkalinity to methyl orange. If phenolphthalein alkalinity is equal to methyl orange, then alkalinity is due entirely to hydroxide. If phenolphthalein alkalinity is more than half and less than methyl orange alkalinity, then hydroxide alkalinity in terms of calcium carbonate equals two times phenolphthalein alkalinity minus methyl orange alkalinity.

Chlorine (C):

Titrate the same samples with a solution of silver nitrate (4.791 grammes per liter of water), using 1 c.c. potassium chromate as indicator (dissolve 5 grammes of potassium chromate in water and add silver nitrate until red precipitate begins to form. Filter and dilute to 100 c.c.) 1 c.c. of silver nitrate solution is equivalent to 1 mg. of chlorine. One-tenth of a milligram is equal to one part per million if a sample of 100 c.c. has been used.

P H:

Under this heading the figure reported represents the hydrogen ion concentration, and is as determined by use of the La Motte color comparator. With regard to hydrogen ion concentration and the exact significance of the figures reported in our analysis, we quote Speller, "Corrosion —Causes and Prevention," page 16, as follows:

"Pure water is very slightly dissociated or decomposed into hydrogen ions and hydroxide ions. The produce of these two qualities is always a constant in water or in any aqueous solution, and the value of that constant is approximately 10-14 at room temperature. Hence, if the concentration of the hydrogen ions is 10-4 equivalents per liter, then the concentration of the hydroxide ions is 10-10. The acid properties of solutions are due entirely to hydrogen ions; the alkaline properties to hydroxide ions. When these ions are present in equal amounts, the concentration of each is 10-7 and the solution is neutral. This would be the case in pure water. Acid solutions are those which have a concentration of hydrogen ions greater than 10-7. Alkaline solutions are those with hydroxide-ion concentrations greater than 10-7. For convenience, this is expressed as the log of 1, which is given the symbol Ph. This pure neutral water has a PH of 7; acids, a PH value of less than 7; and alkalies a Ph of more than 7."

The chemical properties of a soil are dependent upon the nature of the dissolved matter in the soil water and variations in concentration of the substances in solution. The soluble constituents of soil water include the dissolved gases; inorganic acids, bases and salts, particularly the alkalies, magnesium, sulphate, calcium sulphate, sodium and magnesium chloride, sulphuric acid and the like. The nature of these salts has a marked influence in the corrosiveness of this area. It depends on their nature and concentration. Varying concentrations set up a galvanic action that flows from the weaker to the stronger solution. Magnesium and calcium sulphate and sodium chloride are often found in corrosive areas. Poorly drained sections near oil wells will show large percentages of chlorine, sodium and potassium which are corrosive. Alkalies, such as sodium carbonate and sodium silicate, retard corrosion by neutralizing the acid radicals. Low PH values indicate a corrosive condition, especially when correlated with collodial content. When the survey is finished and considered with other variables of drainage, topography, soil profile, etc., we then assign values which are drawn on right-of-way map in different colors, corresponding to our findings. This gives a comprehensive idea of what protection is necessary.

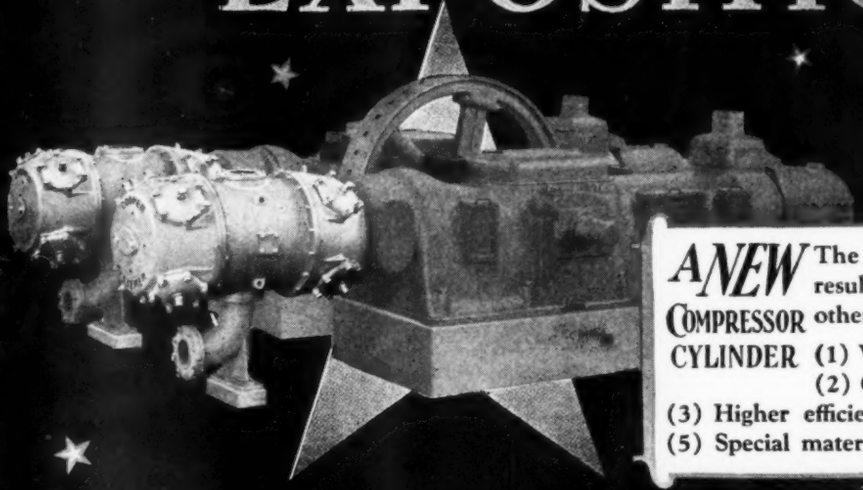
The success of any present-day manufacturing concern depends chiefly upon quality and uniformity of its products. In this day of science and technical exactness in the oil industry, it falls to the lot of the laboratories to give to the buying public that assurance of quality and uniformity.
—A. Henriksen.

As soil corrosion falls within the scope of electrochemical theory, it follows that if the pipe in only known bad soils is protected, then the remainder of the line, even in better soil, will be more or less affected. Therefore, the whole line should have some protection. With this in mind, the superintendent is furnished a map showing the soil conditions and can then distribute the protection accordingly.

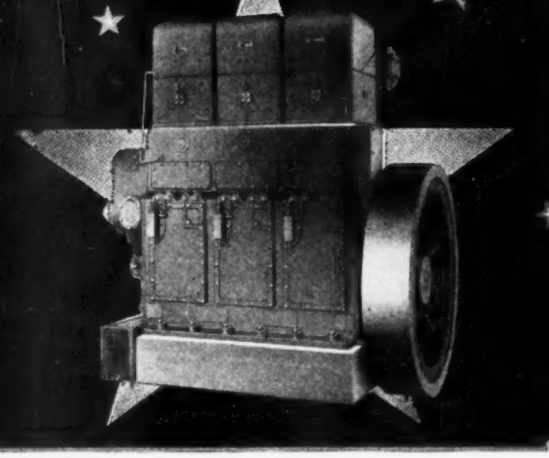
Laboratories have conducted annual tests for several years, using the market's better known coatings. These tests are accelerated by selecting known corrosive constituents to make up the soil and keep it quite moist. Coatings that survive the "graveyard" are believed to have superior possibilities. Such a coating was selected for the Quinton line. This particular coating was used some five years ago in a very corrosive area and recent inspections have shown it to give excellent protection. No structural material in coating is to be used on this line, as the soil classification does not seem to justify the extra expense. Of the 80 miles that this line transverses, there were only a few corrosive areas as found by the various tests. These locations were found in damp, ill-drained areas. The coating program calls for double or treble protection in these places and will vary with character of backfill, extent, moisture, etc. This extra protection will take care of possible voids or holidays in first coat.

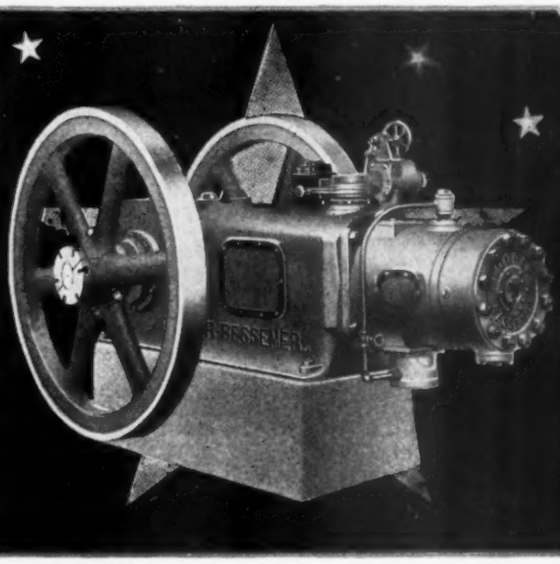
We are fortunate in having men directly in charge of construction, coating and inspection who are thoroughly familiar with coating application and behavior, thereby reducing the possibilities of ill protection to a minimum. The coating company also has a service engineer on the job whose duty is to assure good application of the product he represents.

NEW STARS AT THE EXPOSITION



A NEW COMPRESSOR CYLINDER The following improvements are the result of our own and the experience of other builders of compressor cylinders: (1) Valve-in-head construction, (2) Clearance reduced to a minimum, (3) Higher efficiency, (4) Better water cooling, (5) Special materials giving extra strength.





A NEW TYPE VERTICAL The following points are evidence of the sound engineering behind this compact, clean-cut, convertible engine (75 to 200 B. H. P.): (1) Main frame of ample strength, (2) Die-forged crank shaft, (3) Drop forged connecting rod, (4) Separate mixing valve for each cylinder, (5) Silent roller chain driven cam shaft, which is carried on roller bearings.

A NEW TYPE GA Careful field study of pumping and drilling engines is responsible for the following features, found in Type GA engines (25 to 50 B. H. P.): (1) Timken main roller bearings, (2) Die forged crank shaft, (3) Sturdy main frame, (4) Improved air valve, (5) Special materials where needed.

The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, Grove City, Pa.

COOPER-BESSEMER

When writing The Cooper-Bessemer Corp. *please mention The Petroleum Engineer*

Operating Conditions *in the* West Asher Field

THE new Wanette or West Asher field of southern Pottawatomie County, Oklahoma, offers comparatively easy drilling, but recently the area had its first blowout. The well blew wild for nearly a week and threatened seriously to crater.

Few wells in the pool have reported a sand at about 2000 feet in the rotary hole. However, a test of the Prairie Oil & Gas Company had gas break in behind the pipe at this point. It flowed gas and water, causing neighborhood drilling wells to shut down.

The gas later broke out through cracks and crevices 75 feet away from the derrick. These gradually grew larger and for a time it was thought the well might crater.

A string of tools was hung over the top of the casing to prevent the gas blowing high into the air. The crew working on the derrick of this wild well finally succeeded in running a string of 10-inch pipe over the 8¼-inch casing string. This 10-inch casing was cemented at 773 feet, with the result that the gas escaping was shut off, including that coming up through the crevices.

The eight-inch string was ripped from 2200-08 feet, permitting the gas to come up the eight-inch pipe. It was gauged at from 20 to 25 million cubic feet.

A number of new tests have been commenced in the field following the completion of several good wells, and the area is now second only to the Oklahoma City field in activity in the state.

The average producing depth is about 3500 feet, although this varies from between 3450 and 3600 feet in different tests. The general practice has been to set but two strings of casing—the surface pipe and a string just above the sand. The surface pipe is 12½ inches diameter, set at 75 to 100 feet and cemented to the surface, which requires approximately 125 sacks of cement or more. The next, and last, string of casing is 8¼-inch, usually made up of 120 to 130 joints. This is usually cemented with 300 sacks.

The tests are drilled with rotary tools to the top producing horizon, where, after setting pipe, standard tools are rigged up for drilling in.

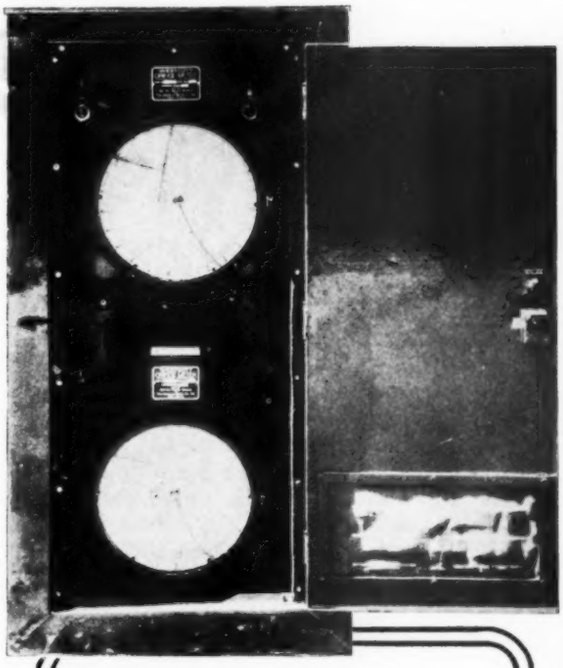
Most of the wells have been natural flowing completions, but some have lacked the pressure to flow and have been placed on the pump at once.

The topography of the area is mildly rugged, being made up of small sand hills covered with timber, and with several small creeks.

The area has assumed the appearance of a small boom at this time, with trucks busily rushing equipment to locations.

TWO TYPICAL FIELD SCENES AT WEST ASHER

System of on Leakage



The box at the curb houses a duplex installation, consisting of a 50" and a 10" Westcott Orifice Meter as used by the Los Angeles Gas and Electric Company to check leakage in each district throughout their high pressure system. Placed between curb and walk it is easy to change charts. Testing is provided for by placing taps beside the meters; and the box can be fitted with bleed pipes from the manhole close by. The manhole gives access to the orifice disc in the gas main and to meter connections. With the 10" meter for measuring low volume flow and the 50" for measuring high volume flow, a record of maximum accuracy is obtained. Such installations permit exact knowledge of leakage by districts and quick location of the fault with only a fraction of the effort involved when the whole system must be examined.

FOR minimizing leakage in high pressure distribution, the Los Angeles Gas and Electric Company has a solution. The entire piping system is divided into comparatively small districts. Then, for each of these districts, the gas is measured by a Master Metric Orifice Meter.

The desirability of saving gas through subdivision and early discovery of leakage need not be stressed. The main value of this announcement lies in the fact that a progressive Company has actually evolved a successful modern method that is suited to widespread application in high pressure distribution. And, similarly, for low pressure work, a Metric Orifice Installation, designed for an average of one inch differential loss, offers comparable advantages.

Our research service and data are always at the command of any Gas Company considering a measuring problem of this character.

Complete information is also available on Linderman Orifice Meters, Metric Indicating Flow Meters, Metric Rate Volume Controllers, and Metric Ironcase Displacement Meters.

METRIC METAL WORKS
ERIE, PENNSYLVANIA
IRONCASE, TINNED STEEL CASE and ORIFICE METERS

AMERICAN METER COMPANY
INCORPORATED
The World's Largest Manufacturers of Gas Meters and Allied Apparatus
ESTABLISHED 1836

SALES SERVICE · ERIE · DALLAS · TULSA · DENVER · LOS ANGELES
SAN FRANCISCO · KANSAS CITY · PITTSBURGH · CHICAGO
PHILADELPHIA · NEW YORK · BALTIMORE · BOSTON · ALBANY

AMERICAN METER CO
MEASUREMENT ENGINEERS
CUBIC FEET

TRENDS *in* Proration Methods *and their* Effect on Oil Production

By H. S. HAURY, *Petroleum Engineer, Simms Oil Co., Dallas, Texas*

THE writer has been much interested in the proration movement and has followed closely its development in the West Texas fields. An attempt is made in this article to analyze the trends in methods of proration and their effect on some phases of oil production.

When it became necessary to restrict the rate of production in oil fields, efforts were made to prorate the pipe line outlet on an equitable basis. Originally proration was applied only to fields with large flush production—developed or potential—but latterly it has been necessary to restrict some fields where the production is settled and the oil is produced by pumping wells.

The rights of the several parties interested — namely, the neighboring operators and the royalty holders — were pretty thoroughly defined under the old method of rapid competitive drilling and producing. Proration agreements were drawn up with the objective of maintaining the same production ratio between the several properties in the field that would obtain were there no restriction of the rate of production. This principle is still dominant in proration theory. It soon became apparent that proration plans must be devised so as to permit an operator to develop his leases with fewer wells than were formerly drilled — or at least develop the leases at a slower rate. The diminished rate of return was found insufficient to support the heavy outlay of capital that went into a lease under the old plan of rapid competitive drilling. This whole matter was further complicated by fear of going contrary to the anti-trust laws.

Oil collecting ditches along the banks of the Pecos River, Yates field, Texas.

History of West Texas Proration

Several West Texas fields were placed under proration early. Of these the production was most drastically restricted in the Yates Pool, of Pecos County. The proration problem was given most thought there and proration practice has been most successful in that field. As a consequence, other Texas proration agreements have been modeled more or less after the Yates plan.

A review of the development of the Yates plan will be instructive. The field was first prorated on a straight, well-potential basis. This scheme seemed feasible while there were few wells in the field, but it invited the several operators to drill rapidiy to increase their total potential and thereby their relative participation in the field outlet. It soon became apparent that under this plan the capital expenditure would rapidly mount to the point where the relative rate of return on capital outlay would be negligible.

After three months the plan was changed to an acreage basis on the theory that this would remove the incentive for further drilling. A geologist was employed by the proration committee to delimit the productive and potentially productive area of the field. All operators participated in the pipe line outlet in the ratio that their acreage held within the line delimiting the productive area of the field to the total acreage within that line. This removed the incentive for further drilling except on leases that lay outside the agreed productive limit where considerable drilling was done in an effort to extend this limit and thus bring more acreage into participation.

The porosity and permeability of the productive lime vary greatly and with them the productive capacity of the wells. Much opposition to the plan developed on the part of several operators whose wells had a far greater productive capacity than the average for the field. Some arbitrary adjustments were made to compensate for this.

Other difficulties developed under this plan. Several leases near the crest of the structure were extensively drilled. The owners of these leases held other undrilled tracts nearer the edge of the field, but within the agreed limit of production. Under this proration plan, oil allocated to these operators for this marginal acreage was withdrawn from the leases at the top of the structure. This set up unduly rapid withdrawals in this area of intensive production and excessive drainage on leases lying down dip from this area. As these latter leases are in an area where the flow is mainly due to hydrostatic head, it was held that they would suffer through an increased rate of the advance of the edge water.

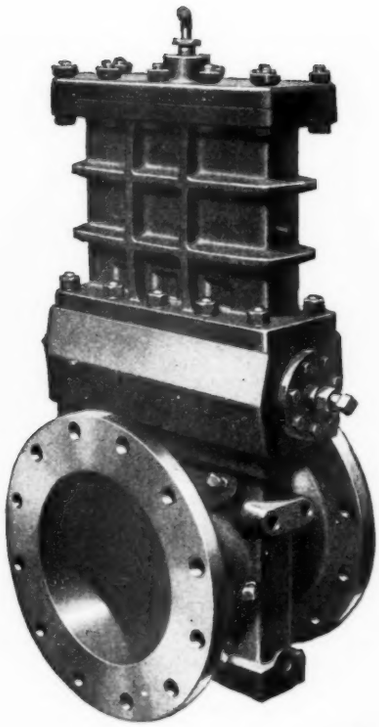
Difficulties with the royalty interests also developed.

Two schools of thought formed among the operators at this time; one favoring proration on an average basis and the other proration on a potential basis.

Meanwhile a potential plan was developed by several operators embodying the unit area feature so as to permit an operator to bring acreage into participation with a moderate amount of drilling. It was held that the productive rate (the potential) of the wells on a given unit area is the most feasible measure of the productive capacity of that

ROBINSON
ORIFICE FITTINGS

MEASURE FLOWING GASES AND FLUIDS ACCURATELY . . . . . .



But they do more than provide accuracy. They simplify the method of changing an orifice meter plate and eliminate the expense and inconvenience of the old-style by-pass. During the short time taken to change the plate, the gas flow is not interrupted and there is no hazard due to leakage. No chance of stopping gas flow or breaking orifice flanges.

These are some advantages of Robinson Orifice Fittings. There are many others! They explain the preference of experienced operators for Robinson Orifice Fittings. And they present a reason why YOU, too, should investigate Robinson superiorities before you buy any fittings.

The easiest and quickest way to get complete details about these efficient Orifice Fittings is to send the coupon below for *your* copy of the new Robinson catalog, just off the press. It's Free!

ROBINSON ORIFICE FITTING COMPANY
1435 Santa Fe Avenue — Los Angeles, California

Distributors:

THE FOXBORO COMPANY, Foxboro, Mass.
Chicago, Dallas, Houston,
Los Angeles, Pittsburgh, Tulsa

WESTCOTT & GREIS, Inc.
Dallas, Houston, Los Angeles, Tulsa

English Distributor:
WALKER, CROSWELLER & CO.
54-58 Queen Elizabeth Street
London S. E. No.1

Canadian Distributor:
PEACOCK BROTHERS, Ltd.
Montreal, Calgary, Winnipeg

ROBINSON ORIFICE FITTINGS

NEARLY 13,500 ROBINSONS IN SERVICE

MAIL THIS COUPON TODAY

Please send me your new catalogue without obligation on my part.

Name_____

Address_____

City_____

area if produced without restriction. Potential production in the Yates Pool has always been measured by gauging the one hour's open-flow of each well. In order not to compel the drilling of additional wells, it was proposed to use the average potential of all wells on the unit as the potential of the unit. Thus one producing well would bring a unit into participation ratably with units that had more wells, whereas an operator would be free to drill other wells on the unit if he believed that he could raise the average potential by so doing.

A compromise was agreed to, under which 25 per cent of the outlet is prorated on acreage and 75 per cent on average potential. The proration unit adopted was 100 acres. This acreage allowance is sufficient to justify the operation of such units as have a potential so low that their outlet on potential allowance would be insufficient for profitable operation. It should be mentioned here that a minimum outlet was set for such wells, while operating under the two earlier plans.

The field has been operated under this acreage and potential plan since July, 1928. The State Railroad Commission took over the administration of proration at that time. Operation under this plan has been smooth and harmonious and practically all operators in the field are strong advocates of proration.

The maximum daily withdrawal was 136,000 barrels. The present outlet is 100,000 barrels daily. The theoretical potential capacity of the field (based on one-hour open-flow gauges) is in the neighborhood of 5,000,000 barrels daily. It is estimated that the field could not sustain a production greater than 30 per cent of this amount if opened up for any considerable length of time. Nevertheless, this represents a drastic restriction in the rate of production. The field had produced in excess of 87,450,000 barrels to July 1, 1930, with little decline in total potential. While there is some decline in production and in pressure in the less permeable areas, where the flow is due to gas pressure, this decline is a small fraction of the total flow capacity of the field. Put in other words the depletion of natural energy, available for flowing oil over the entire field, is a small fraction of the total energy that was available when production was started.

There has been comparatively little advance of water in the field. This is in marked contrast to other West Texas fields that were prorated more or less half-heartedly. So thoroughly do the operators appreciate the benefits derived from this drastic proration that they all would oppose a material increase in the rate of production.

Oil treating plant, Yates field, Texas.

Other Texas Fields

The Hendricks Pool, Winkler County, has been under proration since early in 1928. There the unit area is 40 acres. Of the pipe line outlet 50 per cent is prorated on acreage and 50 per cent on potential. The outlet was not sufficiently restricted to prevent the rapid advance of water. This latter was true of the earlier proration in Howard County. An effort has been made more recently to bring the Howard-Glasscock Counties proration into conformity with the more logical Yates plan. The handling of water is a serious problem in the two older Howard-Glasscock areas. A maximum allowance per well was set for these areas at such a point that water would not gain on the rate of production and spread farther. All wells of smaller capacity in these areas were allowed to pump to capacity. The remainder of the field was prorated 25 per cent on acreage and 75 per cent on potential with 40 acres as the unit area. Further reduction of the outlet forced the abandonment of this plan.

The Ector County proration is 25 per cent on acreage and 75 per cent on average potential with 40-acre units. A minimum is set of 150 barrels per well on the unit.

The Panhandle has a minimum of 50 barrels per well. All wells are first given an allowance of 50 barrels. If under 50 barrels they are allowed to produce to capacity. A factor is obtained by subtracting the oil necessary to satisfy this 50-barrel allowance from the total field outlet and dividing the remainder by the total field potential less the oil allocated on the 50-barrel allowance. The excess potential over 50 barrels of each well is multiplied by this factor to obtain the well's additional potential allowance. A similar plan is proposed for Crane and Upton Counties.

The Hobbs pool, Lea County, New Mexico, is prorated on the Yates plan with 40-acre units instead of 100-acre units.

Economic Limit

While newer proration plans are modeled more or less on the Yates plan, there is some sort of recognition of an economic limit in all of them, that is, a minimum allowance is set for wells whose capacity is so small that their allowance on potential would be too low to pay for continued operation. The Railroad Commission of Texas has recognized this principle in a recent order, applying the State-wide proration, in which marginal wells are defined as wells of such small productive capacity that restriction of their output would compel the shutting down of these wells. The order suggests for consideration a marginal line of six barrels daily for wells to 2,000 feet in depth and 12 barrels daily for wells between 2,000 feet and 3,500 feet in depth. While the commission's regulatory power is purely in the interest of conservation, that is, for the prevention of physical waste, the economic factor enters into the question of conservation on these marginal wells. The order points out that to reduce the outlet of such wells would force the operator to shut them down and probably abandon them, thus causing the permanent loss of recoverable oil.

Proration Between Fields

The pipe line companies' nominations determine the outlet for each field at the present time. Contracts and the relative desirability of the oils in the refineries served, gov-

erned these nominations. The Railroad Commission has tentatively set the outlet for the several districts in the State, but its order makes no provision for the equitable division of this district outlet between the several fields in the district.

The restriction imposed on some fields by the pipe lines is most drastic while others go practically Scot-free. What can and will be done to obtain a more equitable division of the outlet between the several fields, remains problematical. Some readjustments would contribute materially toward stabilizing proration in general.

It is self-evident that an established regulation of production throughout the country is desirable both for the producer and for the gasoline consuming public. If this cannot be achieved there is certain to be a collapse that will wreck many companies and cause the abandonment of large numbers of smaller wells that can be produced for a long time if the industry is stabilized. The public would in the end stand this economic loss.

It is certain that we will be producing oil for a lower average price than has prevailed at times in the past. This can be done successfully only if development and production costs are reduced to conform to the available market. Carefully formulated proration plans are the most generally applicable means so far devised to accomplish this reduction in costs. Unit operation is the only other means so far proposed for attaining the same results. This will, in the main, be applied only to new fields and would do nothing toward protecting the large capital and the oil reserves in the fields now developed. Proration at its best, as demonstrated in the Yates field, can secure all the benefits attainable through unitization; retaining at the same time greater flexibility, greater stimulation toward technical progress, and the advantage of leaving each property to the operation of its owner.

Mid-Kansas Marathon machine shop, Yates field, Texas.

The restricted production of flush fields is bringing about a change in the valuation of producing properties. First, with development properly controlled, the original capital expenditure is less than was customary under former methods of operation.

Second, under restricted flow, the fields produce with natural flow for a much longer time. This tends to extend the time of low-cost production and also to increase the total amount of oil recoverable at low cost through conservation of the natural energy stored in the oil reservoir. Further, it avoids breaking the oil market by throwing a large excess production on the market in a short time and makes a large saving in cost storage.

As a number of such fields is developed these fields with low-cost production are jointly capable of supplying the bulk of the market requirements, so that this low-cost oil becomes, in large measure, the determining factor in the price of crude. The large number of small pumping wells were formerly considered the backbone of the industry. This type of production is rapidly losing its relative importance and standards for evaluating small pumping properties will have to be revised.

A distribution of outlet in the same ratios that would obtain, if the production were unrestricted, has dominated proration thought. Lately, considerable attention is being directed toward engineering phases with a view to reducing gas-oil ratios and thus conserving the natural energy. Some operators believe that the flow should be restricted to a point that secures the lowest gas-oil ratio and that this consideration should govern the allowable production from every well. Some California fields are prorated on this basis. There the State authorities have made the conservation of gas the dominant issue. Proration rules for some West Texas fields and for the Hobbs pool, in New Mexico, require that the wells be produced through tubing and engineers of several of the companies there are devoting a good deal of study to reducing the gas-oil ratios.

The potential factor, in the Yates type of proration plan, requires the determination of the flow capacity of the wells which so far is made by open-flow tests. These periods of open flow may injure some of the wells, especially wells that are close to edge water. Several large wells in the Yates pool, that produce clean oil when the flow is restricted to their normal production, will, on the one-hour open-flow test, show a water cut before the end of the hour.

The operators desire some other method for determining potentials in order to avoid this danger and also the cost and confusion incident to making open-flow tests of these large wells. To find such a method, company engineers have conducted some experiments in the Yates pool with encouraging results. Tests on several wells indicated that the rate of flow varied directly with the pressure drop and that this curve projected to zero pressure gave the same rate of flow as the open-flow test. Several such tests in the Hobbs pool showed similar results. There is reason to believe that the open-flow capacity can be found by determining the flow capacity at two or three different pressures and projecting this curve. To demonstrate this more definitely, however, a large number of tests will be required to determine flow relations, both as to gas-oil ratios and as to capacity, are being conducted in the Yates pool jointly by an engineer in the employ of the proration committee and by a committee of company engineers. Similar work is being done in other fields.

Our knowledge of what happens in a producing well is very fragmentary. Much work remains to be done in this field. Sclater and Stephenson pointed out that we need closer study of the expenditure of natural energy in producing oil—that the method which expends the least amount of gas and pressure in producing a barrel of oil is most efficient. They described some instruments used in such studies and pointed out needed improvements.* It seems likely that eventually we will set a maximum pressure drop for regulating the flow of wells in prorated fields.

*Measurements of original pressure, temperature and gas-oil ratio in oil sands. K. C. Sclater and B. R. Stephenson. Transactions A. I. M. E., 1928-29, Pet. Div.

TAG an of

Fitting shown is Key Forged Steel Sectional Type Stream Line Flow Fitting—quickly dismantled for cleaning of tubes. Its design reduces pressure drop through coils to a minimum, eliminates turbulence and prolongs the life of tube ends.

Be sure to visit our exhibit at the Exposition in Tulsa. Our representatives will be glad to discuss your particular requirements with you.

KEY RETURN BENDS

When writing KEY BOILER EQUIPMENT CO. *please mention The Petroleum Engineer*

G E D

additional guarantee Performance

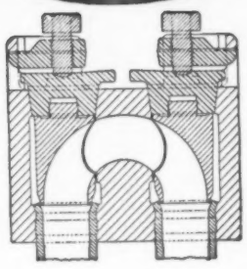
KEY Refinery Fittings have always been designed with a careful consideration of these three factors—

MINIMUM PRESSURE DROP
UTMOST EFFICIENCY
HIGHEST FACTOR OF SAFETY

Now, every Key Fitting which leaves our plant bears this Guarantee Tag as your absolute assurance that it will perform satisfactorily and safely.

Key Refinery Fittings have been tested and proved in practically every refining center in the world. They have been designed for every type of still construction—especially in installations which require unusually close spacing of tubes. Key Fittings are made in many shapes, sizes and styles, designed for varying operating pressures and temperatures.

Write our nearest office for complete information on Key Fittings.



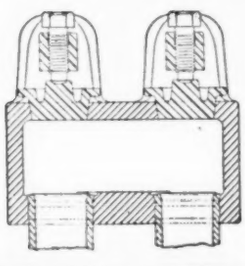
Key Return Bend Fitting, with deflectors and radiused port, providing an uninterrupted flow of oil through the fitting. Sectional view shows barrel type deflectors attached to the hand hole plugs, but open-face deflectors are optional.

KEY BOILER EQUIPMENT CO.
EAST ST. LOUIS, ILLINOIS

NEW YORK CITY
1237 Chrysler Building

TULSA, OKLAHOMA
733 Mayo Building

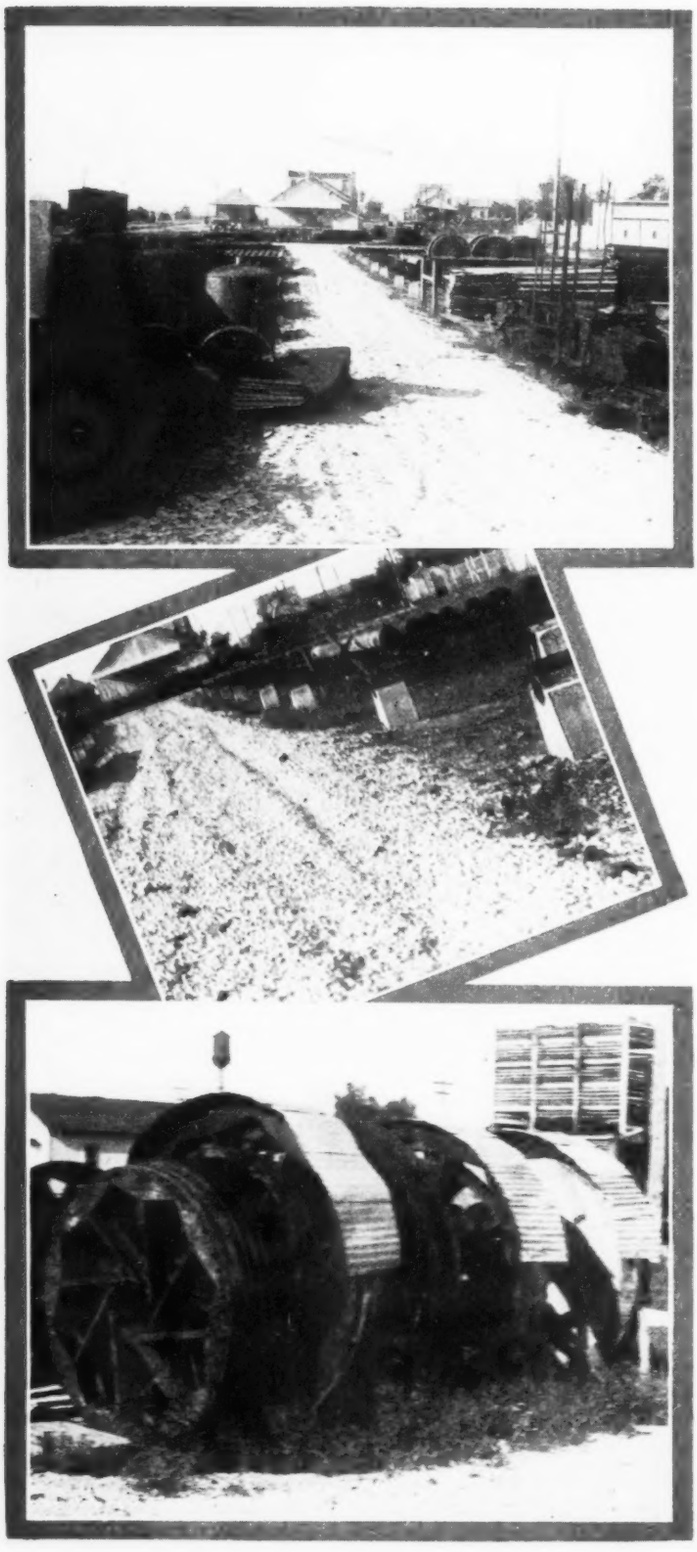
LOS ANGELES, CALIFORNIA
2814 Santa Fe Avenue



Plain box type return bend, with projecting ear lugs to retain holding members. Can also be made with same style of holding members as shown above.

KEY RETURN BENDS

Winona Warehouse Has Several



THE Winona, Osage County, Oklahoma, warehouse of the Indian Territory Illuminating Oil Company, has recently been improved with additional facilities, particularly in the matter of yard equipment. It now represents one of the largest layouts in Osage County.

The warehouse services a large area, including the Hominy and Pawhuska, Okla., districts, in addition to Wynona, in the same state. Most of the wells in this vicinity of eastern Osage County are gas wells, or small oilers.

It serves not only as a storage place of new equipment and parts, but also as a storage ground for old material brought in from the field. One end of the yard is devoted to new pipe and casing of various diameters, while the old used pipe is stacked up separately.

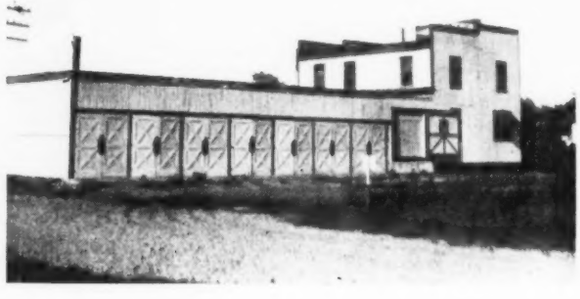
All of the pipe is kept off the ground by concrete posts, rising about one foot high. The tops of these are circled out, permitting the laying of a joint of pipe across them. The remaining pipe is stacked on this pipe, being laid in the opposite direction. This makes a very substantial support, neat in appearance, and also keeping the casing off the dirt.

A feature of the layout is the keeping of material, both old and new, out of the weather. As previously told, all pipe is kept off the ground. In the center of the yard is a rack constructed several feet high for the purpose of raising wheels and the like that are connected on shafts off the ground. The rack is constructed out of old pipe. Bandwheels are covered with old pieces of tin to protect them as much as possible.

A feature of the efforts to protect used equipment from the weather is the storing of fittings and other small equipment in a small house, known as a bin. A glance at this structure does not reveal that it is different from any other shed, but has several unique ideas attached to its design.

The roof of the bin is equipped with two trap doors. This enables trucks to back up to the shed

Left, top to bottom—View up one of the gravel roadways in the yard. Concrete pillars for supporting pipe. Bull-Wheels covered with sheeting. Below—Office, warehouse and garage building.



Equipment Protection Features

and let the workmen literally toss the material in the bin through the trap doors. It is quite low and when on a truck bed, this can be done with ease. The interior of the bin is divided into three compartments, which allow for a rough assortment of the small materials placed in it. The boards on the side of the building look permanent, but are arranged so that they may be removed like an end-gate of a wagon. This is for the purpose of removing heavy equipment that cannot easily be lifted through the trap doors.

A railroad spur runs immediately back of this junk bin, and along the entire back side of the yard. This enables the shipping in or out of equipment, without long hauls.

When old equipment is brought in from the field it is stored until its value can be estimated, as well as the cost of repairing. If it is decided economical to have it repaired it is sent to a reclaiming plant of the company, which necessitates the use of the railroad.

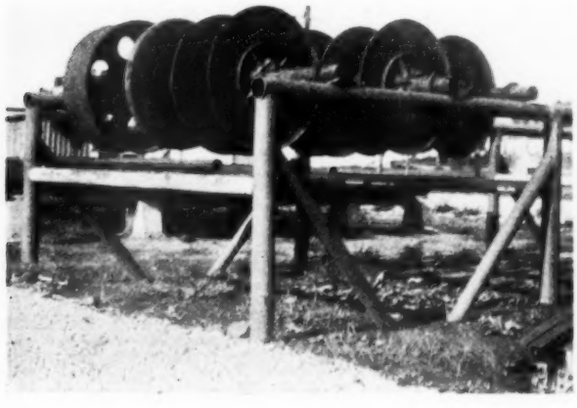
The warehouse building proper has offices in front, with sleeping rooms overhead. Behind the warehouse rooms are garages for the employees' cars. In addition to the main large building there are several smaller docks and sheds for storing various kinds of equipment.

All roads throughout the yards have been heavily graveled, permitting the taking of a truck to any part of the yard. The yard is also systematically laid out, with roadways leading to all racks.

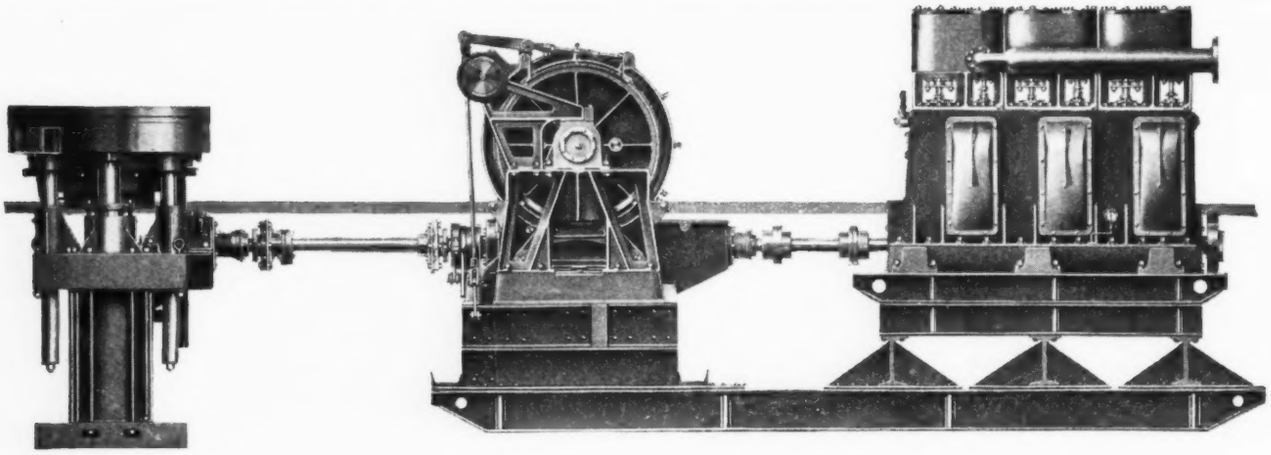
Frank A. Zimmerman is the storekeeper and E. A. McKee is assistant storekeeper.

The crew of the warehouse naturally is deeply interested in effecting as many economies as possible by limiting equipment damage. They have established excellent records in this connection.

Right, top to bottom—View of some of the docks. Frank A. Zimmerman, storekeeper. The bin. Below—Rack made of old pipe for storing equipment.

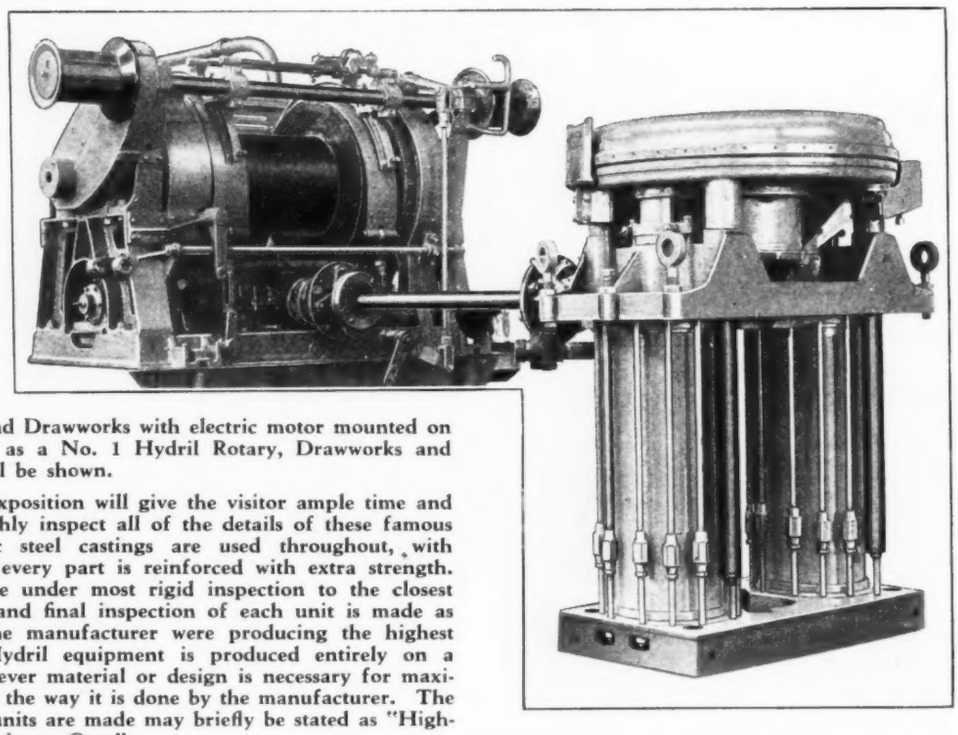


HYDRIL



The complete No. 3 Hydril unit, consisting of Rotary Table, Drawworks and 3-Cylinder Steam Engine, will be exhibited at the National Petroleum Exposition. Demonstrations will be made of lowering and raising the table and rotating the table at various speeds. The unit will be connected up exactly as though it were being operated upon an actual well.

TRADE MARK REG.
HYDRIL



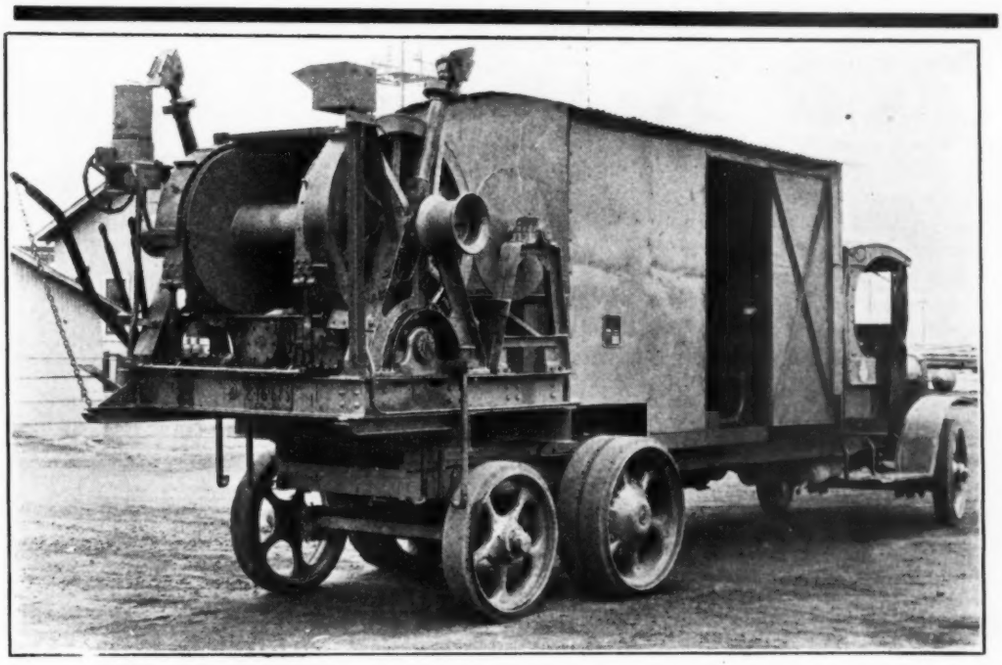
No. 2 Hydril Rotary and Drawworks with electric motor mounted on a steel frame—as well as a No. 1 Hydril Rotary, Drawworks and electric motor outfit will be shown.

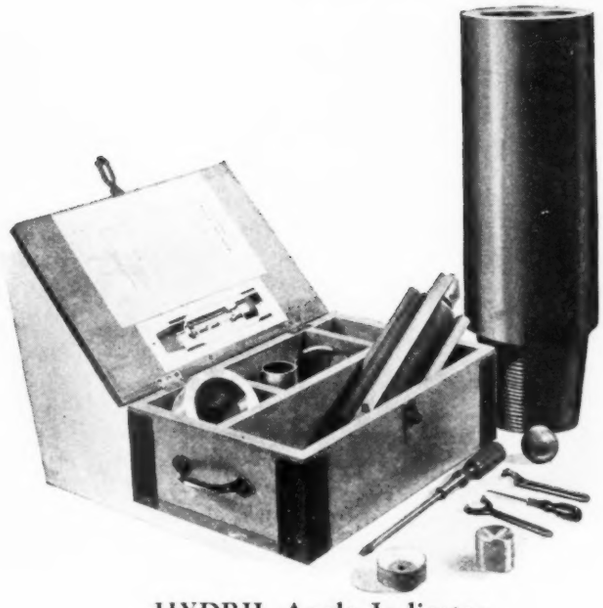
These exhibits at the Exposition will give the visitor ample time and opportunity to thoroughly inspect all of the details of these famous Hydril units. Electric steel castings are used throughout, with Timken bearings, and every part is reinforced with extra strength. The machining is done under most rigid inspection to the closest tolerances. Assembly and final inspection of each unit is made as carefully as though the manufacturer were producing the highest priced automobile. Hydril equipment is produced entirely on a quality basis, and whatever material or design is necessary for maximum efficiency—that is the way it is done by the manufacturer. The policy on which these units are made may briefly be stated as "Highest Quality—Lowest Ultimate Cost."

The reputation earned by actual drilling operations is the highest, and drilling speed records have been made in the major fields by Hydril equipment. Be sure to see the Hydril Exhibit.

EXHIBITS FULL LINE AT TULSA . . .

The Hydril No. U-2 well puller suitable for mounting on truck or trailer will be a part of this great showing of Hydril drilling equipment.





HYDRIL Angle Indicator

In addition to the Hydril units, there is a collection and demonstration of the Hydril *Packing Head Gas Control*, mounted on a section of casing and so installed to show its actual operation under gas pressure which may be read to 750 pounds by the gauge.

Other important items to be seen are:

OVERSHOT and CORE BARREL.

FLUSH JOINT DRILL PIPE, TOOL JOINTS and FLUSH JOINT CASING AND COUPLINGS.

DIFFERENTIAL BIT PRESSURE GAUGE.

RECORDING BIT PRESSURE GAUGE.

HYDRIL ANGLE INDICATOR.

DALE & NIELSON OIL WELL SURVEYING INSTRUMENT.

Diagrams and Photographs giving complete information.

DOHENY STONE DRILL COMPANY

714 West 10th St., Los Angeles

Cable Address: HYDRIL, Los Angeles

When writing DOHENY STONE DRILL COMPANY *please mention The Petroleum Engineer*

A Tour of the » » » »
EASTERN OIL FIELDS

By B. H. LEONARD

B. H. Leonard, the author of this article, is a brother of A. W. Leonard of the Devonian Oil Co. of Tulsa, Okla. He recently completed a tour of the fields which have been called the "Cradle of Petroleum." His experience and the yield of his camera are here presented.

THE oil fields east of the Mississippi, aside from their importance in the early development of the industry, still open opportunities for those who make a close study of them. On a tour of some 3500 miles, extending from southwestern Ontario through the Trenton Rock fields of Ohio and Indiana and into Illinois, returning by Kentucky and the Appalachian fields, the general expression of opinion was that old wells could be reconditioned and brought into production, additional acreage either untested or unfairly tested could be developed, and new methods could be brought into play. It is far from being a territory of mere strippers.

Petrolia, Canada, is an oil man's town. There are perhaps two thousand wells still producing in an area five miles long and three miles wide. Beyond the local refinery are some of the oldest and best pumping wells, equipped with short wooden beams saddled on posts a few feet in height. Depth to the corniferous lime is about 430 feet, and the output a half to one barrel of oil and considerable water. Several of the old powers of the push-and-pull type are cumbersome affairs with huge flywheels. One of these in times past had handled as many as three hundred wells. In the present day these old engines still turn over, driven through a series of great belts and pulleys by small motors.

The Canadian system of drilling as used here, and in many foreign fields, strikes one watching it in operation as a matter of pulling ropes to work controls. From time to time the driller pulled a rope, the ratchet wheel up by the beam revolved a cog, and the chain which serves in place of a temper screw slid around the slipper out, which is fastened to the top of the beam, and so lowered the clamps holding the line. A wire line was used in this instance in place of the iron, sucker-rod-like poles. The drawworks are housed around the crank end of the beam and controlled by ropes attached to wooden levers. In starting a hole a horse may be brought in on the derrick floor to turn an auger through the surface clay.

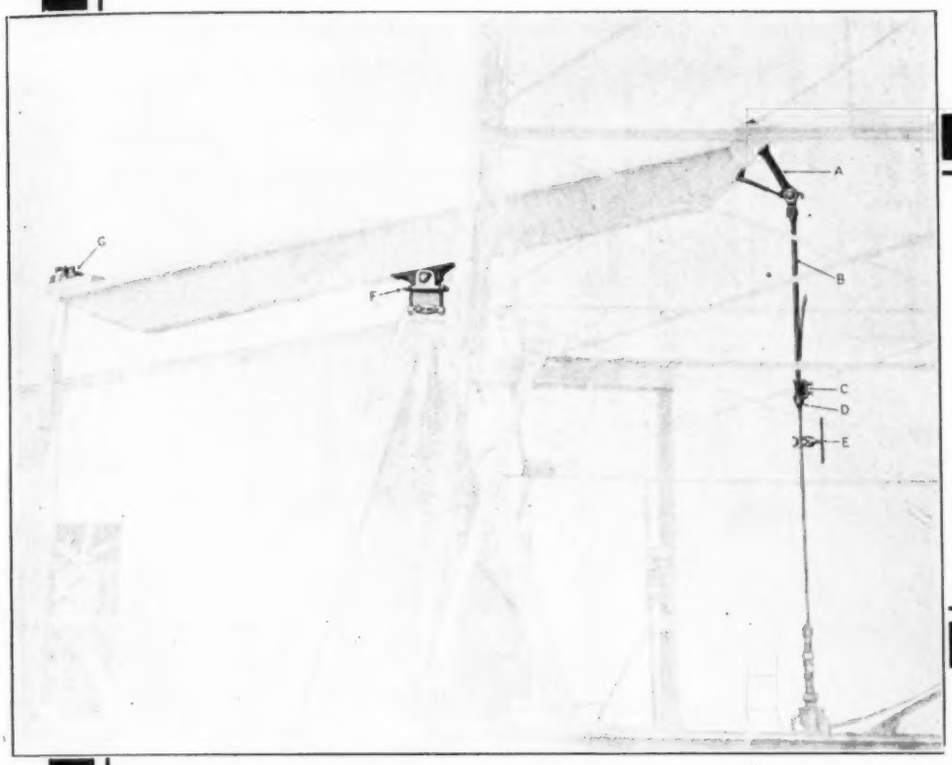
Thin streaks of high productivity run through the Petrolia field. In order to prevent a neighbor from pulling a vacuum across the line, a means adopted was simply to seal the lead in a line well by shooting mud into the pay, which, in the soft part, is only a few feet thick.

The field south and east of Oil Springs does not cover the area of Petrolia's, but the three-pole rigs are more closely set; the wells are somewhat deeper, the oil of a higher grade. The gum beds here, of which traces remain, were worked as early as 1857 by J. M. Williams, founder of the Canadian oil industry, who dug holes and timbered them, thus securing the oil. One of the steadily operated properties here has 135 wells on one of the old powers now driven by a 20-horsepower motor. A feature of present-day practice at Oil Springs is to take advantage of the spring and fall rains. Then the little beams bob rapidly to catch the flood oil as it passes up to the next property, after which the beams are idle until the next season.

Site of the Merrick well at Rouseville, Pa. Henry Rouse was burned when the well caught fire and died a few hours later. This happened April 17, 1861.

About 20 miles southeast of Oil Springs are the pools about Bothwell. The oldest trends some three miles east to west, with a half-mile width. Booms have come and gone since the Lick well of 1866. It was supposed that Bothwell lacked staying qualities, yet some of the first wells, including the Old Company's, which antedated Lick's, are still producing. In this section was an exhibition of pumping with speed and

Extremely Long Working Life With Little Upkeep Expense



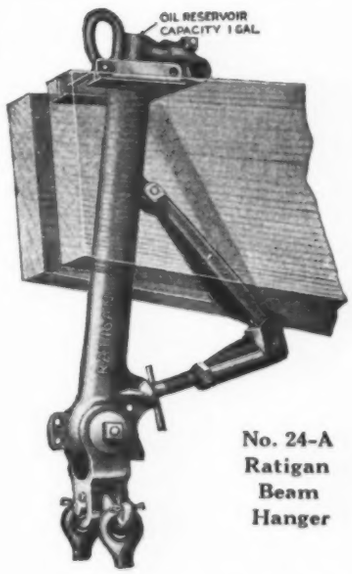
RATIGAN EQUIPPED PUMPING RIG

Illustration shows straight pull obtained with Ratigan (a) No. 24-A Universal Oil Bath Beam Hanger with No. 19 Equalizer Bar. (b) No. 38 Hanger Rods. (c) No. 7 Polish Rod Grip. (d) No. 22 Carrier Bar. (e) No. 2 Heavy Polish Rod Clamp. (f) No. 12 Walking Beam Rocker. (g) No. 39 Pitman Stirrup Bearing.

Phosphor Bronze Bearing

Positive lubrication is assured at point of bearing contact by gravity feed. Babbitt seal prevents loss of oil, and one filling lasts about six weeks.

No finer Beam Hanger has ever been built than the Ratigan No. 24-A Universal Oil Bath Beam Hanger illustrated herewith. Its value has been field-proved on thousands of pumping rigs throughout the United States, and at the present time is giving satisfactory service on wells pumping as deep as 7000 feet. It is small, but compact and exceptionally strong—has successfully withstood a pull test of 100,000 lbs. and will last indefinitely. Write for the complete Ratigan Catalog.



No. 24-A Ratigan Beam Hanger

Designed to fit on any Beam—either steel or wood—without special adjustment or alterations to the beam. Recommended for any length stroke. Provides a straight pull, minimizing strain on rods.

No. 24-A-25 Wheel and Yoke Assembly

This sheave wheel is optional equipment for wire line suspension.

J. P. RATIGAN

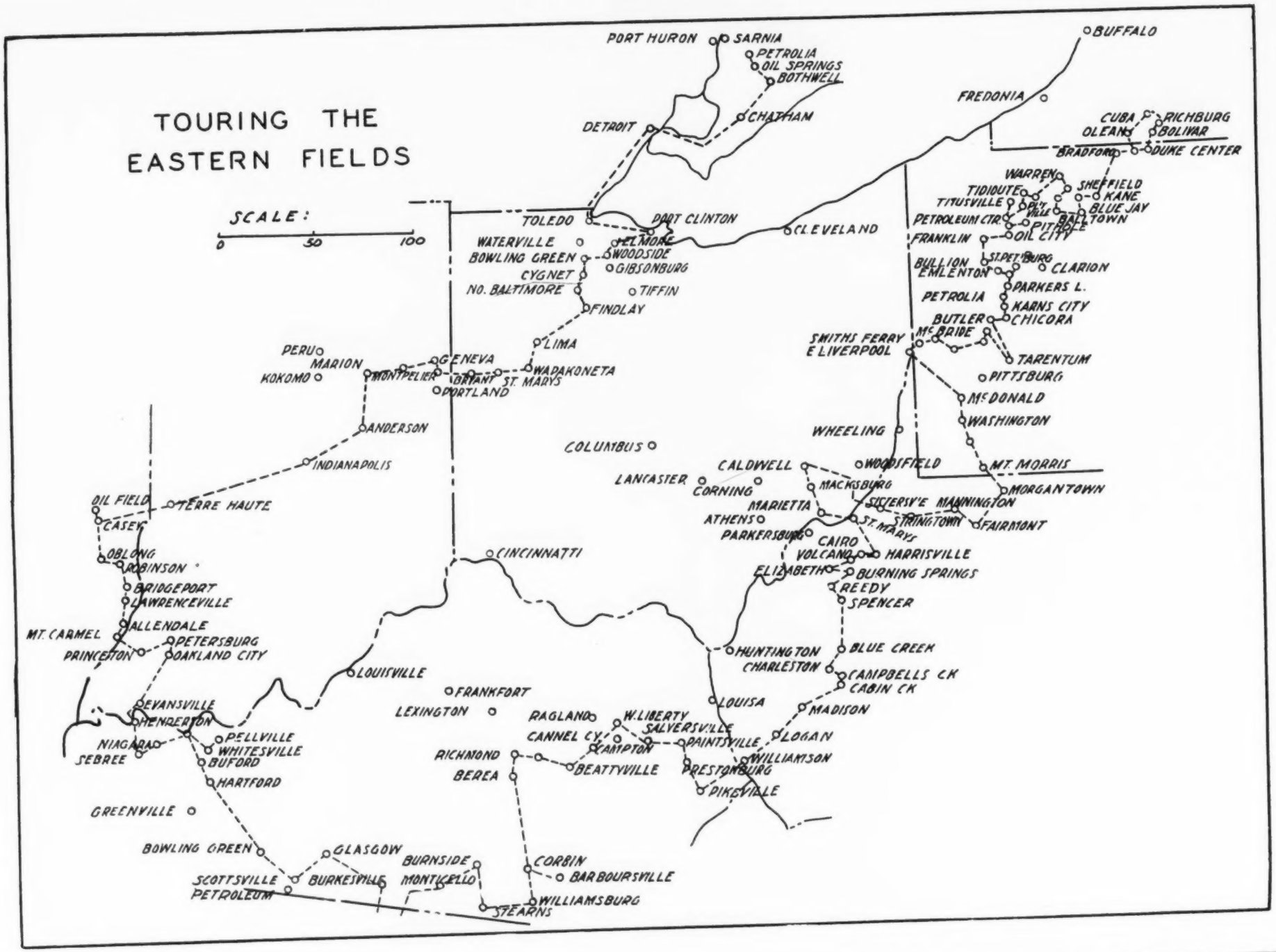
Manufacturer

1213 Santa Fe Avenue, Los Angeles, Calif., U. S. A.

New York Office—30 Church St.
Los Angeles and New York—All Codes

Cable Address "RATIGRIP"

When writing J. P. RATIGAN *please mention The Petroleum Engineer*

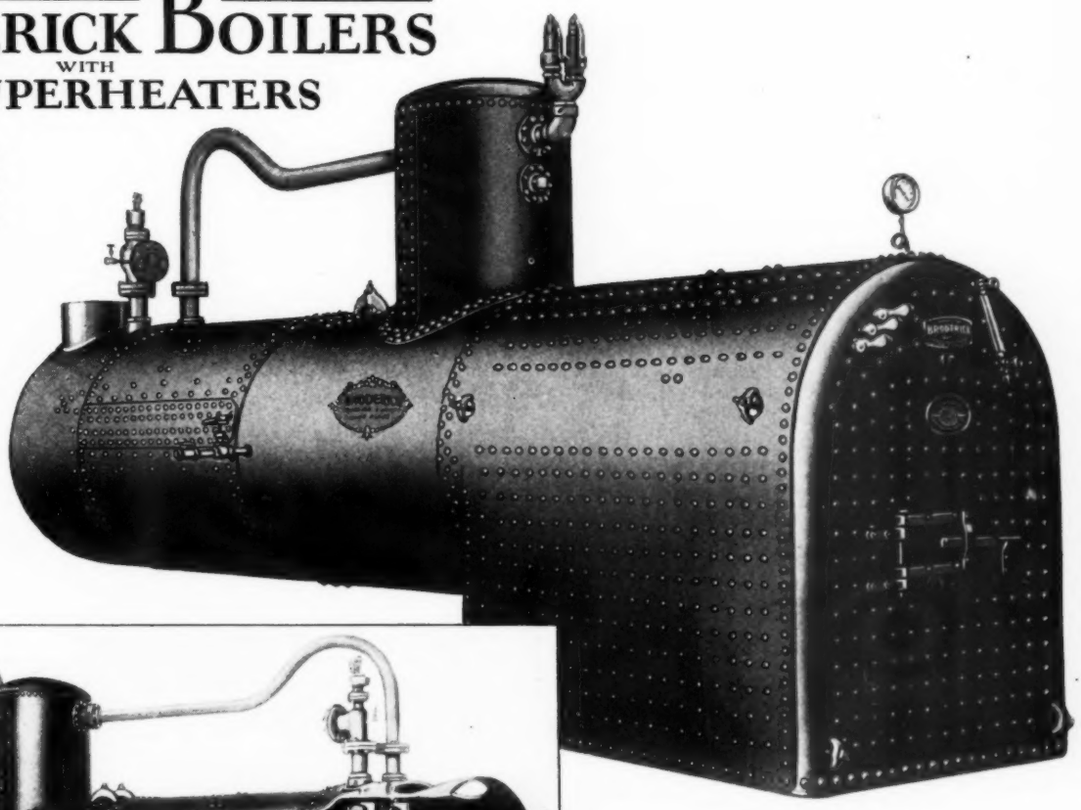

TOURING THE
EASTERN FIELDS
SCALE:
0
50
100
PORT HURON
SARNIA
PETROLIA
OIL SPRINGS
BOTHWELL
CHATHAM
DETROIT
TOLEDO
PORT CLINTON
CLEVELAND
BUFFALO
FREDONIA
CUBA
RICHBURG
OLEAN
BOLIVAR
BRADFORD
DUKE CENTER
WARREN
SHEFFIELD
KANE
TIDIOUTE
TITUSVILLE
OIL CITY
BLUE JAY
PETROLEUM CTR.
PITHOLE
FRANKLIN
OIL CITY
BULLION
EMLENTON
ST. PETERSBURG
CLARION
PARKERS L.
PETROLIA
KARNS CITY
CHICORA
BUTLER
SMITHS FERRY
E LIVERPOOL
McBRIDE
TARENTUM
PITTSBURG
McDONALD
WASHINGTON
WHEELING
MT. MORRIS
MORGANTOWN
MANNINGTON
FAIRMONT
WATERVILLE
BOWLING GREEN
CYGNET
NO. BALTIMORE
FINDLAY
ELMORE
WOODSIDE
GIBSONBURG
TIFFIN
LIMA
PERU
MARION
KOKOMO
GENEVA
MONTPELIER
BRYANT
PORTLAND
WADAKONETA
ST. MARYS
ANDERSON
INDIANAPOLIS
COLUMBUS
CINCINNATTI
LANCASTER
CORNING
CALDWELL
MACKSBURG
MARIETTA
ATHENS
PARKERSBURG
WOODSFIELD
SISTERSV'E
STRINGTOWN
ST. MARYS
CAIRO
VOLCANO
HARRISVILLE
ELIZABETH
BURNING SPRINGS
REEDY
SPENCER
OIL FIELD
TERRE HAUTE
CASEY
OBLONG
ROBINSON
BRIDGEPORT
LAWRENCEVILLE
ALLENDALE
MT. CARMEL
PRINCETON
PETERSBURG
OAKLAND CITY
LOUISVILLE
FRANKFORT
LEXINGTON
RAGLAND
CANNEL CY.
CAMPTON
RICHMOND
BEREA
BEATTYVILLE
W. LIBERTY
SALVERSVILLE
PAINTSVILLE
PRESTONSBURG
LOUISA
HUNTINGTON
CHARLESTON
BLUE CREEK
CAMPBELLS CK
CABIN CK
MADISON
LOGAN
WILLIAMSON
PIKEVILLE
EVANSVILLE
HENDERSON
NIAGARA
SEBREE
PELLVILLE
WHITESVILLE
BUFORD
HARTFORD
GREENVILLE
BOWLING GREEN
GLASGOW
BURNSIDE
MONTICELLO
CORBIN
BARBOURSVILLE
SCOTTSVILLE
PETROLEUM
BURKESVILLE
WILLIAMSBURG
STEARNS

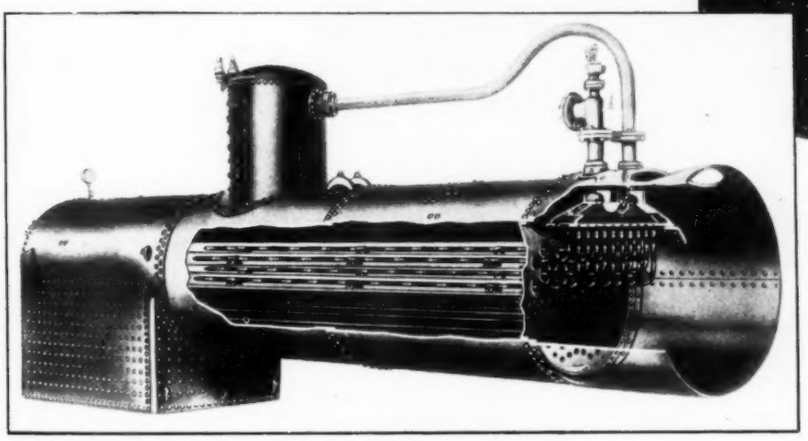
ment » Fuel » Water

BRODERICK SUPERHEATERS have brought to oil well drilling what superheated steam engines have given to railway locomotives... increased steam capacity with smaller equipment... or a reserve capacity with available portable boiler sizes... and dry steam to make greater pump and engine speeds safe.

BRODERICK BOILERS
WITH
ELESCO SUPERHEATERS

Continuing the reputation of Broderick Boilers for over fifty years.



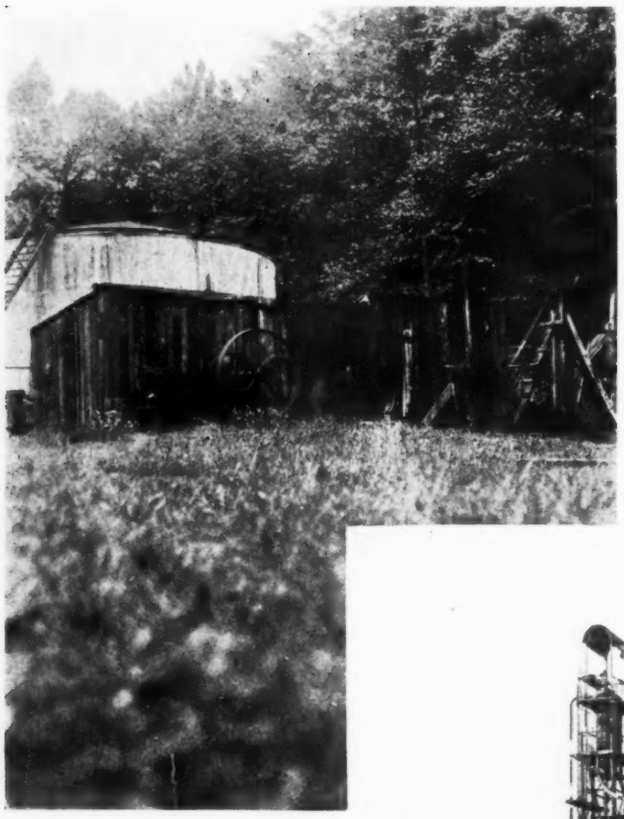


At left—Cut-away view to show the flow of hot gases around tubes, changing saturated steam into dry steam.

Manufactured by

THE BRODERICK COMPANY
Boiler Manufacturers
MUNCIE, INDIANA U. S. A.

When writing THE BRODERICK CO. *please mention The Petroleum Engineer*



This old well at Emlonton, Pa., has been producing since 1867.

long stroke, where two wells, 10 feet apart, strove valiantly to handle the sulphur water so that one of them at least might have oil to show, and a nice stream of lively green oil was separating out in the receiving tank. Farther west, near the cemetery, a test was drilled to 4100 feet and ran into granite. The Trenton is upward of 3000 feet below the surface hereabouts in Canada, but so far has not been proved productive.

The northern limit of Trenton Rock production is about Toledo, Ohio, and the eastern about Port Clinton. The producer has invaded beautiful Catawba Island and scattered a few oil and gas wells over it, the earliest perhaps being the Hines well of 1923, with a depth of 2172 feet, and production is now around 80 barrels a month.

Westward up the Portage River the principal field is that adjoining Elmore. The Trenton lies at about 1250 feet for production, while dips as little as 20 feet from that mean dry holes. In some areas the Clinton carries gas around 600 feet in depth. A repressuring operation carried on in this vicinity so far has proved inconclusive.

Near Woodside in the Gibsonburg district is the oldest pumping well in this part of the Lima field, and was first a gasser supplying Prairie Depot. In ordinary procedure old wells are pulled, and a handful here and there may be all that is left in an area that was drilled up for miles. The Cygnet field south of Bowling Green was an exception; this was the most extensive area of pumping wells encountered, running on south-southwest between North Baltimore and Findlay. At Cygnet is one of the main stations of the Buckeye Pipe Line Company with triple expansion engines driving pumps of as high as 2400 barrels capacity per hour in the movement of Mid-Continent crude to eastern markets.

Little remains at Findlay except a casing projecting here and there to remind one of the days when gas was king of the town. The Ohio Oil Company maintains its headquarters here, having just moved into its new building on Main street. The company is the chief operator in the Trenton Rock and Illinois fields.

At Lima the Buckeye Pipe Line has its main office. Here also is the Solar Refinery. Until the problem of how to treat Lima oil, which runs high in sulphur, was solved by adopting the Frasch method, great amounts were accumulated in 35,000 barrel tanks by the Buckeye. One of the big tank farms lay just south of Lima, near a rich part of the field. Only small bunches of wells are now found there, most of them of later development. Further south about Cridersville operations are more active. More recently Trenton Rock development has gone on south of St. Marys, reaching into Shelby and Drake counties.

The main Trenton Rock development passed into Indiana, about Bryant and Keystone, in 1890-91. Drilling in the main was soft, but

The Kendall refinery at Bradford, Pa.

A scene in the Oil Springs field of Canada.

there is the Lob or Big Drive, an underground channel in the lime, winding right through the town of Geneva and requiring the use of 600 feet of drive pipe. Southwest of Geneva a deep test showed 565 feet of Trenton, penetrated the St. Peter and the Potsdam, then obtained a show of oil at 2,340 feet and amber oil at 3,255 feet. The well stands unfinished with the unsolved problem of how to shut off the water and make a test of the amber oil sand of some 25 feet, which is deemed likely to prove commercially productive. The western limit of Trenton Rock oil production is beyond Montpelier in the vicinity of Marion, with the exception of small areas about Peru.

At Terre Haute, on the western side of Indiana, oil was found in drilling for water in 1865. Some development followed, of which nothing now remains.

Illinois came to the front in 1904 with a strike of oil near Casey. Development of the territory along the LaSalle anticline was rapid. The Casey sand averages 300 feet in depth; other sands are named for Robinson and Bridgeport, and several, such as the McCloskey, Kirkwood and Buchanan, for the farms where encountered. In certain small areas also the Niagara and Trenton are producing. For the deeper drilling the standard cable-tool system generally is used in connection with the steel derrick. As in most of the old fields some water is produced with the oil. Also as in other fields many wells were pulled for their casing during the World War. Bridgeport is the center of the largest number of wells, some of which are on town lots. Lawrenceville and Robinson have the refineries of the Indian and Lincoln refining companies, respectively. South of Lawrenceville an eastward extension of the field toward the Wabash is seen at Flat Rock. Further south, in the neighborhood of Allendale, are found scattered pools, new ones of small area being found from time to time, with the Biehl sand around 1,400 feet as the principal objective.

Mr. De Moss, aged 87, who has lived in the Volcano field of W. Va., since 1865, and has participated in the drilling of more than 500 wells.

Passing into the Southwestern Indiana field, of which Princeton is the supply point, conditions similar to Allendale's are met with and extend through several counties. Development dates back beyond that of Illinois, but has been slower. Some of the area has been spoiled by too deep drilling into the sand. Wells are more expensive owing to the amount of casing required. However, there is some drilling going on, and new production being added as the operators feel their way. The Princeton sand is found at about 800-900 feet, and has been producing near the town for a quarter century or more. Other sands lie around the 1,100, 1,400 and 1,800-foot levels in this vicinity. Pike County has sands called Cunningham, Rumbler, and Barker, besides the Oakland City at about 1,500 feet.

Western Kentucky, in the Owensboro section, is a development largely of the past seven years, beginning to the east of the Jett farm in the Pellville area and swinging south, thence west with the Rough Creek fault. More activity with the drilling machine is displayed in some of these pools than can be found elsewhere. It is a matter of only 600-800 feet, with the prospect of striking rich spots like the Ambrose-Weller, Barnetts Church Creek and Buford, all of recent development, where wells of 200 to 400 barrels size were brought in, the Jett sand being the main producer. Besides Buford, at present the most active of Western Kentucky pools, another busy scene is presented at Niagara, where a sand is encountered at about 700 feet in depth.

Bowling Green's entrance into oildom dates only from the Davenport well of 1919. No pool in this section has been found as extensive as the Davenport which trended northeast-southwest five or six miles, the main pay in the Niagara lime around 1,000 to 1,300 feet. Much of the production of Western Kentucky from Allen County northward to the Ohio at Owensboro is handled by the Illinois Pipe Line Company through the former Indian Refining Company line to Lawrenceville, Illinois.

Many of the Allen County pools about Scottsville have passed out; depths here ran as little as 50 feet; Gainsville, one of the most prolific spots in this section, has many wells still producing, the depth being around 300 feet.

Barren County operations center at Glasgow, which has the facilities of a small skimming plant, also the pipe line of the Paragon Refining Company reaching to the Cumberland River region. Oil excitement dates back to 1865 when the Boyd's Creek, later called Oskamp, pool was opened. Near a spring in the creek the first well found oil at 135 feet, or 30 feet below the black shale. It averaged 17 barrels a day production over a period of 25 years. The oldest wells are now abandoned, however, later ones are still producing, some of them drilled among the old wells. The latest efforts have been directed to developing the gas found at about 600 feet depth. While most of the oil produced runs around 38 gravity, some of the Glasgow pools obtain an amber oil from pockets above the shale and this is an inducement leading to the opening of new spots from time to time.

Out from Burkesville three miles is the site of the famous American well of 1828-29. Drilled for salt water, it gushed forth oil which ran down the creek into the Cumberland and caught fire. Later the oil was bottled and sold as American Medicinal Oil. The county became the mecca of many producers from Pennsylvania, and has, ever since the early sixties, been the scene of more or less active operations. Formerly the oil was taken by barge to Nashville, but the

SURWEL Clinograph

Surveys direction and degree of deviation

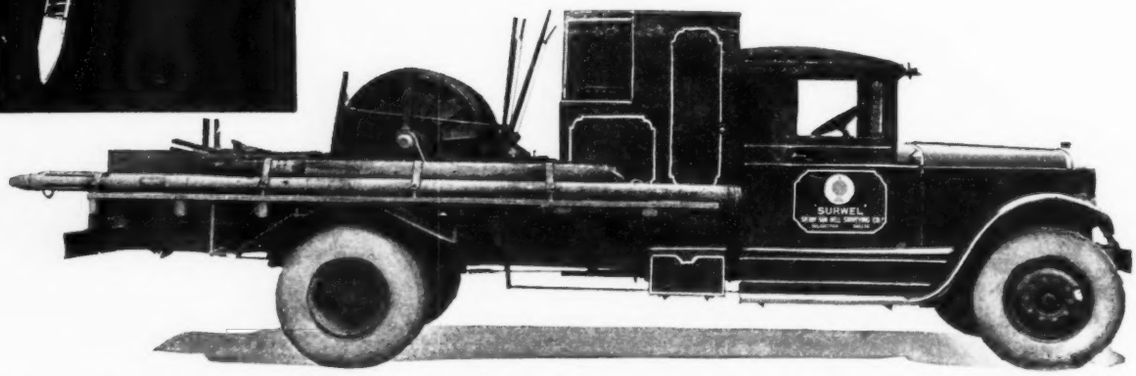
ONE of the most progressive steps in drilling operation is the well survey — safeguarding the driller from too great a deviation from the vertical. Unfortunately for wells already drilled such surveys do not go far enough. They fail to tell the *direction* of the deviation. The operator therefore does not know whether his failure to strike oil is due to drifting away from pay sand or crossing into close proximity to another well.

Now comes the SURWEL CLINOGRAPH, an instrument that tells photographically and accurately, not only the degree of deviation but the exact direction of the drift. Wells which have been abandoned in likely territory should be surveyed by the SURWEL. Geologists, too, will find a survey with SURWEL very helpful.

SURWEL is not sold but operated on a service basis by our own experienced crew. Costs and complete data will be given on request.

SPERRY-SUN WELL

Main Office — 1608 WALNUT STREET
PHILADELPHIA



SYFO CLINOGRAPH
For Surveying Drilling Progress

"MORE haste, less speed" is an axiom that has been accepted by drillers today as worth following. Not only is more care being taken to hold drilling to the vertical but daily check-ups are the order of the day.

The SYFO CLINOGRAPH is a most practical instrument for surveying drilling progress. It is safe—no acids employed. It is fast—operates on drill stem, wire line or by "Go-Devil" method. The record is on paper—easily read and permanent. It is extremely accurate. It is inexpensive—both to operate because it delays drilling progress for only short periods and because the lease cost is nominal.

Many operators today, knowing the accuracy of the SYFO Clinograph, are insisting that the driller use the SYFO, allowing him only a fixed latitude from the vertical.

The SYFO Clinograph is not sold, but leased at nominal rates. Being made in different sizes for different depths, it is necessary for the drilling company to advise the conditions under which the surveying will be done before quotation can be made.

Write for complete descriptive literature

SURVEYING CO.

Dallas, Texas
1504 FIRST NAT. BANK BLDG.

Tulsa, Oklahoma
402 PETROLEUM BLDG.

Houston, Texas
1420 ESPERSON BLDG.

main areas such as Kettle, Sulphur and Crocus Creeks, now have outlet through the Paragon line. Some of the production is below the black shale about 100 feet below in the Sulphur pool which is being reopened. At a lower horizon lies the Pencil Cave, with sands at several levels underneath it, both here and across the line in Tennessee.

Eastward along the line in Kentucky are the Wayne County pools, some two dozen in number, of which Cooper on Beaver Creek and Mt. Pisgah to the southeast are among the chief. Beaver Creek and Sunnybrook sands are well known, the former at 600 to 800 feet as the main producer. On some properties a vacuum is maintained on the wells, and in Oil Valley some gasoline has been made in connection. The oil goes to the Cumberland pipe line. Development has been active at various periods, especially in the late nineties and preceding a transfer of interest to Western Kentucky. It may be noted that oil was first found in 1818 when Martin Beaty drilled for salt water on the South Fork of the Cumberland near the Tennessee line in what is now McCreary County.

From Irvine, Kentucky, spread east and northeast the oil fields of Eastern Kentucky, mainly in the Irvine-Paint Creek faulted area. Some of the wells, the oldest at Ravenna, are not more than 80 feet deep, while those in the main Irvine field vary from 400 to 600 feet, according to surface elevation. Through to, and including the Big Sinking field, it is the cornif erous lime which has been so productive. The oil of 38 gravity, goes in part to the Texas Company refinery at Pryse on the Kentucky River southeast of Irvine. There it is fractionated in a tower and the distillate for cracking goes to a cracking unit. Kerosene is treated in the ordinary batch agitators, while the cracked gasoline passes through continuous treaters. Special naphthas are also made. Coke, produced in running the crude to and from the cracking stills, is powdered to furnish a portion of the fuel requirements. It may be observed that the stillmen are mostly natives who have adapted themselves readily to Port Arthur practice.

Pumping well in the Volcano field of W. Va. The shackle rods are carried over wooden wheels.

Big Sinking is impressive. The main part lies at the bottom of a narrow valley over which tower sandstone cliffs. Out of these confines the field spreads over the hills into several counties, and ten to twelve years ago had no equal in the state in activity or in output. Even now it presents a lively scene there in the hole with its melange of pipes, stations, pull lines, powers, camps and shacks contending with the wells for space. It is easy to understand after viewing this rough area, why teams of oxen were often employed to negotiate steep slopes as well as muddy roads in western Kentucky.

In the Johnson-Magoffin Counties field northeast of Salyersville, the Wier sand lies around 1,000 feet just below the Berea. The main Wier sand pools are further northeast. Attention was turned to this area some 25 years ago when a spring of oil burst forth on the Conley farm near Falcon. Four miles east is Oil Springs on Little Paint Creek. Paint Creek and its tributaries have figured in the annals of oil since long before the Civil War, when floating oil was gathered and shipped from Lawrence and Johnson counties. Today there is little left of early operations. Attention is now given more to the development of gas, especially in the counties to the south of the oil belt.

Drilling in the Kanawha Valley as in much of the Appalachian field, is characterized by a quick change in formation, on account of the various oil sands following one another in close succession. Just above Charleston, at Marmet, drilling for gas was in progress with the Maxton and Berea as the main possibilities. At Cabin Creek, about 20 miles above Charleston, one of the largest of Berea pools was opened up in 1914, and developed largely by the Pure Oil Company which had a refinery near the mouth of the creek. There are several hundred wells, each with its own rig, including the steel derrick; altogether the largest assemblage of its kind seen on the trip. The Berea lies at about 3,200 feet, the structure is that of a synclinal trough, being one of common occurrence in the Appalachian field and in many localities not carrying water.

The story of the beginnings of drilling methods and appliances goes back to the well drilled in 1806 by the Ruffner Brothers on the bank of the Kanawha about 10 miles up from the Charleston. Briefly, they sank a sycamore or gum which had been hollowed out to four feet diameter enabling a man to dig inside of it. On reaching bedrock, they springpoled the well down to the concentrated brine. With a leather bag of flaxseed packed about the tubing, they were able to shut off the weaker solution above. The site of their old well, like many others, is now covered by the Kanawha, which has been slackwatered, but here and there one of the old gums may still be seen sticking out of the water. Two or three miles above stood the Tompkins' salt works, to which gas was brought in 1840 for heating the salt pans, probably the first commercial use of gas in the country, although it had been discovered in Charleston in 1818. Near the Tompkins' house is what is referred to as the Burning Spring, around which George Washington took up a tract of land.

Another large pool in the Charleston area lies north on Elk Fork at Blue Creek. Wells here are 2,200 feet in the Squaw sand, individually pumped. Many of the rigs are equipped with walking beams constructed of casing to which pipe has been welded for bracing. To the north at Falling

Rock is the Elk Refinery, also the pool about Clendennin.

There is some drilling going on at Liverpool to the west of Reedy in Roane County, but this was not visited on the way to Burning Springs on the Little Kanawha. Not much remains about the town of Burning Springs to indicate that it was once the center of the most populous area in the state. The springs themselves can be only approximately located now. Along the river bank below the town was the Rathbun well, said to have been the first drilled. Here the Cow Run sand lies at about 80 feet in depth. The wooded ridge to the east conceals many wells and several powers, all under one ownership. General Karns started the boom at Burning Springs in 1860 when he opened up one of the old salt wells that had produced oil. Several of the early wells are still pumping, among them the Gracey, Braden, and the Wirt, a near-contemporary of the Drake. Pools were developed at several points along the Burning Springs - Volcano-Eureka anticline, extending north to the Ohio River.

The Volcano (White Oak) field lies eastward of Parkersburg, and is one of the most interesting and picturesque, both in situation and operating methods. It is quite rugged, a fairly good reason for the peculiar hook-up of the pull lines to the wells. A set of three or four rough-fashioned wheels of about two feet in diameter are employed at the jackpost, and the same sort of wheels at frequent intervals to carry the pull line or turn it in a new direction. The wells, and there are many of them, are equipped with short derricks and short, rough-hewn beams. Depth on the hills is about 800 feet. The oil is heavy, about 28 gravity, and some of it is taken directly for lubrication.

Typical pumping well at Petrolia, Canada, field.

Going down into St. Mary's on the Ohio, a good view is obtained down the river toward Belmont and Eureka with the Ohio Refinery in the foreground. This section of Virginia and Ohio has given birth to many sands, among them the Cow Run, Macksburg, Buell Run, Maxton, Cairo and Campbell's Run.

Crossing the bridge at St. Mary's, the highway leads down to Marietta. Back from the river is the Cow Run pool, where drilling began with the spring pole in 1861 near a gas spring. Some of the wells are little over 100 feet in depth. It is now customary here to recirculate gas, putting pressure on certain wells and pulling a vacuum on the others, with benefit to gasoline production.

On Duck Creek north of Marietta, oil was reported found in drilling for salt water early in the 18th century. Development at Macksburg dates from the strike made by Dutton on his farm in 1860. It was surface oil with a depth of about 50 feet, but it led to the search for other sands, several of which proved productive. It is thought that this vicinity offers good prospects now in the Buell Run sand, from which some of the more recent wells are producing.

The Sistersville field, on both sides of the Ohio and extending back from the river through Tyler into the adjoining counties, may be termed the land of the Big Injun sand. Large numbers of wells, some on power, line the banks of the river. Just above the river is the famous Polecat well, which in the early nineties threatened to give the territory a black eye with the great quantities of salt water it then produced. Today it is a steady pumper and marks one of the richest spots in the field. A good idea of West Virginia operations is obtained in a trip up Indian Creek. Here in the neighborhood of Big Moses and Stringtown is a succession of developments pertaining to production, not only of oil and gasoline, but of gas, with their attendant pipe lines and stations. The Big Injun runs about 2,200 feet in depth. It produced the famous Big Moses gas well which had an estimated capacity of from 100 to 150 million feet, and which afforded many spectacular exhibitions of its power. Today the wells are under vacuum. The Bradeh pump station is near Stringtown, a typical roadside oil community. Further on toward Mannington, at Hope, is a compressor station of the Hope Gas Company.

Mannington is remembered chiefly for the deep drilling inaugurated in 1889, and for the numerous and long strings of pipe required for a hole. The Gordon sand runs upwards of 2,700 feet in depth. It was in this area that Dr. I. C. White successfully made practical application of the anticlinal theory, opening up several of the pools.

Near Mt. Morris to the northeast, a roadside sign informs the tourist that the Wade gas well, seen just beyond with its nicely painted connections, was drilled in 1889. Down Dunkard Creek from Mt. Morris oil was reported in the early sixties. Drilling for gas is the main purpose today through much of the Appalachian field.

Many derricks are still seen in the Washington field, where the Gantz well of 1884 and the Gordon a few months later gave their names to sands of Southwestern Pennsylvania and West Virginia.

McDonald made itself known in 1891, when the field ran up a production of around 87,000 barrels in the space of six months and broke the price of oil from two dollars to fifty cents. Some of the large wells are still producing in a belt at the northeast side of the town, their trend carrying over the hill toward the Matthews' well, the greatest producer of its time. The Matthews lies three miles northwest of Noblestown, adjacent to the gasoline plant of the Jennings Company, and it is owned by this company. Originally, Guffey and Galey and Murphy and Jennings owned it and, following the usual procedure in the field, they merely tapped the Fifth sand to start the well flowing.

They later drilled a few feet from time to time which increased the flow, as also did agitation, and at length after a few months the well was shot to start the flow anew. This brought the production up to a rate of 720 barrels an hour. In the first year and a half it was credited with 550,000 barrels and at the end of that period was still doing 100 barrels a day. After thirty-nine years it can show an average of three to four barrels a day. The Fifth sand is around 2500 feet of depth, with the Gordon (the Third north of the Ohio) about 200 feet above the Fifth, productive in certain areas of the field.

At Smith's Ferry on the Ohio, oil was first gathered by means of blankets off the Little Beaver, as mentioned in 1817. Drilling began in 1860, a heavy oil found 50 feet down, and the Berea around 600 feet. The oil now produced is a so-called amber, light green by reflected light and red by transmitted light.

Along the Ohio above Rochester is the Freedom Oil Works, and then a succession of plants which furnish iron and steel, including pipe for the oil industry. In the back country around Warrendale (Brush Creek) are many pools drawing their output from the Hundred Foot, Snee and Boulder sands mainly, with Third and Fourth sand pools east and northeast. In this territory, as in many other areas through Pennsylvania, there is testing for the Speechley sand, a good producer of oil and gas in Butler and Venango counties.

Bakerstown, once a village on the Butler plank road, is now a center for suburban estates, where land values equal the most enticing bonuses in western oil fields. Back in the hollow here in '88 a number of butchers entered the oil game successfully. Their first wells are gone, but the Paton well is still producing on the hill nearby, and offsetting it a well was in process of drilling.

On Thorn Creek was situated McBride City; a few houses remain of this boom town of '84 and '85, and a few wells remain in the creek bottom and on the hills. Wells like the Armstrong (the No. 2 rated at 10,000 barrels a day and as the largest found to that time), the McBride, Phillips, etc., kept the scouts going and resulted in an organization of some sort. Small groups of wells are encountered frequently in Butler County, and often it is the farmer who has taken them over and pumps them.

Just west of Chicora (Millerstown) a considerable number of the old wells are still pumping, from the Third sand around 1600 feet. Between Karns City and Petrolia the Third and Fourth sands crossed, the latter forming the Cross Belt running east and west, with the sand at about 1600 feet or 50 feet below the Third. This part of Butler, and the neighboring portion of Clarion County, furnished the main oil supply in the early seventies. There are several refineries in this part of Butler County; the Starlight and Pennsylvania at Karns City, the Daugherty at Petrolia, and the Butler County at Bruin (Martinsburg). Petrolatum is one of the special products. At the mouth of Bear Creek, a mile below Parkers Landing, is the National Transit pump station receiving Mid-Continent oil and forwarding it to refineries in western Pennsylvania and New York. Along the river at Parkers Landing, wells were drilled in 1868, following the strike two years before at Brady's Bend. The shallow sands of the hills in this vicinity, or Mountain sands, are the equivalent of the Big Injun to the southwest, illustrating the general dip as far as Wetzel County, West Virginia.

In Clarion County the Third sand is found at 800 to 1100 feet. Extensive pools of old wells, now reduced to few, are seen along the highway from St. Petersburg through Turkey City to Knox (Edinburg).

The Ritchey Run district has a number of wells, one near the mouth and still pumping bears the date 1867. At Emlenton there is a local refinery. Westward and to the north of Clintonville, there are still hundreds of wells pumping in the Bullion pool, the sensation of '77, discovered several years after Scrubgrass though the two adjoin. The "Big Injun" and the "Big Pine" of the early days are still producing. There are some First and Second sand producers, but the majority are Third sanders.

Heavy oil production at Franklin dates from the Evans' well of 1859, drilled along the banks of French Creek. The rotting wooden conductor with its leather lining has recently been uncovered. The town became known as the source of lubricating oils, with the old Galena-Signal works of Miller and Sibley specializing in them. Today there are still hundreds of the shallow wells along the runs and on Bully and Point hills producing their quarts and gallons. The Franklin refinery lies above town on French Creek, and the Atlantic at the mouth running up the Allegheny. Between these points and continuing to Oil City and beyond are situated factories and shops well known in the oil industry for such equipment as boilers, engines, pumps and tools. There are many wells on power on both sides of the river about Reno.

Other refineries are seen going up Oil Creek from Oil City to Rouseville, where the large Pennzoil plant is situated. Just below Rouseville was one of the two oil springs of the Creek from which oil was derived and sold before the Drake well established the industry, and to this point Jonathan Watson hastened the day the news got out to take a lease. Near the barrel works a marker indicates the site of the Merrick well, scene of one of the earliest and most tragic fires of oildom. Above the town on the opposite side was the Widow McClintock's farm, source of the wherewithal for Coal Oil Johnnie's more or less exaggerated exploits. Up Cherry Run, near the sites of the Yankee and Reed wells of '64 and '65 the latter making a million for its owners, are little old shallow wells, fearfully and wonderfully hooked up with all manner of rods and jacks. Further along is Plumer, near which stood the Humboldt refinery, largest of its time in the oil country.

Pithole is visualized for what it was in '65. One building only is said to date back that far. With the church on the hill taken as a central point, one may picture all the hills and valleys about as once part of the city crowded in among the derricks. Along the creek behind the church, only grades of railroads and the cellars of wells mark the locality of the United States (or Frazier) well which started the excitement.

Going up the Creek from Rouseville there is observed the Tarr farm, site of the Phillips well, the champion of the oil country; Columbia farm, which paid millions in dividends; Petroleum Center, "The Centre," with the Egbert farm, richest of spots with such wells as the Coquette and Mapleshade, in the flat; the James McCray farm on the ridge; site of the Empire well, and near it Captain Funk's venture which found a Third sand, inaugurating an era of deeper drilling, overproduction, and a consequent drop in oil, making six-dollar oil ten and twenty cents; Pioneer, with the Noble and Delamater well opposite. Further up, Shaffer and Miller farm, to which the first successful pipe line brought oil from Pithole, are reached by side roads descending to the Creek. On the hills on both sides there has been later drilling. Some eleven years ago on the west side, the work of unwatering the Petroleum Center

AN ENGINEERING EXPOSITION FOR THE WORLD'S OIL INDUSTRY

THE *Second Annual Oil Equipment and Engineering Exposition* will again present the best and newest of equipment and methods to the entire oil industry. The Second Annual will be held March 16 to 22, 1931 under the most favorable of conditions and located in its new and permanent home. The largest building, 180 ft. by 400 ft., devoted exclusively to the display of oil equipment...a building with 72,000 sq. ft. of floor space ...will house the inside exhibits; while three acres of outside space will take care of derricks and larger equipment.

A *Permanent Exhibition* is located in the same building and is providing the exhibitor with an all year display of his equipment together with a personal representation by men experienced in field operation and with all types of oil equipment.

Permanency in *buildings* and *service* is given by the Oil Equipment and Engineering Exposition.

Service...to the visitor with a display of the latest types of equipment and a presentation of the newest methods. *Service* ...to the exhibitor with a building designed for exhibiting oil equipment alone. *Service* ...to all with a continuous, all-year contact which is provided to keep the oil men posted on equipment and to advise the manufacturer of everyone, both at home and abroad, who is interested in the kind of equipment he makes.

Foreign representatives who come here to select and buy American equipment are given especial attention both at the Annual Exposition *and throughout the year.* They are assured of seeing the kind of equipment being made for the oil industry.

Buildings...that are built for continuous use...with plastered walls and concrete floors. *A Main Building*...that is spacious ...with perfect lighting and every facility for the most effective display of oil equipment.

MARCH 16 TO 22, 1931

LOS ANGELES CALIFORNIA

area was undertaken, the George Benninghoff farm having 160 wells drilled. This is one of several methods adopted to rejuvenate the Pennsylvania fields, and has been successful in this instance.

Titusville, besides its historical associations, such as the Drake memorial, Drake monument at the well head, and Bell collection housed in the library, is known for its manufacture of oil field equipment. The Quaker State and Penn-Drake refineries are here. To the south there is some activity about Shamburg on the hills above the Creek.

The northern limit of Venango pools may be found about Enterprise and Pleasantville, eastward of which there is a trend leading by Colorado, also active, to Tidioute, to which the descent is made by way of Dennis and Gordon runs with Triumph Hill on the right. Shallow wells were drilled at Tidioute as early as 1860, and the field spread up the runs and across the Allegheny onto the Economites' land. Various sands and grades of oil are found and there is a small refinery. Down the river two miles the Queen sand caused some excitement in 1922, but the Third sand is still the mainstay. Fagundus is situated on the hill opposite.

Warren County fields date from 1876 when David Beaty, drilling for gas, discovered oil at his home across the Conewango from Warren. Many old wells are seen in the flat above toward the Conewango refinery which run about 700 feet in depth. Near the refineries along the Allegheny above town, a grasshopper field was opened several years ago, the chief equipment necessary being a pitcher pump. The County has its own special sands, among them the Warren, Clarendon and Cherry Grove or Balltown. A topnotch oil of Pennsylvania grade is produced. There are two refineries at Clarendon and one at Tiona. Some drilling is going on in the Clarendon district where water flooding is giving excellent results.

Only a few farm houses mark the site of Garfield in Cherry Grove township. There are no wells in this vicinity, where the famous mystery well on Lot 646 in 1882 started a furious, short-lived excitement. Southward on Tionesta Creek, in the vicinity of Porky, there are some wells, and down the road where once flourished Balltown, alone in the brush stands the Freezeout well, some fifty-two or fifty-three years old and still flowing! The winter it was drilled was a freezeout, also later attempts to find production around it. Once a week the stopcock is turned and the well flows its bit. The Balltown sand lies at about 1300 feet in depth. Up the creek near the post office of Trueman is the Cooper Tract; beyond is Blue Jay (Foxburg), where the first successful Blue Jay well raised hope for awhile. The country is spotted, with Second, Third, and here and there Cherry Grove sand wells being found. Sheffield is the main town in this area. Eastward the highway passes a compressor station of the Pennsylvania Gas Company, and so on up to Kane. A splendid new highway runs down into Kinzua Creek shortening the distance to Bradford.

Despite the 20 per cent curtailment then in effect, and now raised to 50 per cent, the field impressed the new arrival with its busy scenes connected with water flooding. Groups of drilling machines and standard rigs were in the process of five spotting various properties. New powers, water stations, new lines have made a new field, but there are, and will be for many years, properties to be rebuilt which are now handled and equipped as in the eighties. The Bradford era of development really began in 1875, and that was ten years after Job Moses found oil at Limestone. It took five years or more to reach a peak here; for one reason, the area was large, some 85,000 acres, not exceeded by any field in the United States, and again the sand may be described as medium hard to hard, yielding up its oil slowly in contrast with the Venango sands, which have soft, pebbly streaks and produce gushers. Bradford in the earlier boom reached a peak of some sixty odd thousand barrels per day, and recently has gone up to half of that amount from a low of 2000 barrels. With the Emery refinery out of commission, there is left in Bradford the Kendall. Another refinery, the McKean County, is situated at Farmersville down from Reid Summit. One of the localities of water flooding has been about Duke Center, along Knapps Creek and branches. The 24-inch water line from the Allegheny up to the neighborhood of Derrick City is planned to serve this section. A visitor to Rock City finds the picturesque rocks the foundation for pumping jacks and rod lines; fortunately the rocks and the views remain as before.

Up from Portville, New York, Bolivar and Richburg in the heart of the Allegheny field are reached and water flooding operations again are seen. On a lease above Richburg the water is obtained at the station from a well some 300 feet deep, and is forced by triplex pump into the key wells under several hundred pounds pressure.

Ordinarily the sand will allow 600 pounds without danger of channeling. Some sixty wells are on the power, averaging about a barrel apiece, each having its own tank set beside the jack. The Richburg sand lies at about 900 feet, sometimes divided into an upper and a lower, and has been found as much as 90 feet in thickness. Other sands are the Quarter Warren around 1200 feet in depth, and the Bradford 1500 feet, the former a good producer of gas as late development has amply demonstrated.

The opening of the Allegheny field was due largely to the persistent efforts of O. P. Taylor of Wellsville, who brought in the Triangle well at Scio in 1880 and aided in completing the first Bolivar producer. There are two refineries close to the field, the Vacuum at Olean and the Sinclair at Wellsville. Over the hills removed several miles from production is the Seneca Oil Spring near Cuba, now preserved in a small park in which stands a monument with a tablet recording the events connected with the spring, which is the first recorded evidence of the occurrence of petroleum in America.

# of Barnsdall Pioneering

INTERNATIONAL PETROLEUM EXPOSITION *in Tulsa*

The high note of this year's Exposition will be the actual reproduction of the Petroleum Industry's First Refinery built in 1860 by William Barnsdall and William H. Abbot on the Parker Farm, Oil Creek, Pennsylvania. Here you will see the first crude beginning of what is now one of the World's Greatest Industries supplying the fuels and lubricants that make possible the other great Industries of the World.

The BE SQUARE *Family of Petroleum Products include:* SUPER-GAS ETHYL; BE SQUARE MOTOR OIL, GASOLINE, KEROSENE, BRIGHT STOCKS; *Greases and all forms of Greases and Lubricants for Automobiles, Trucks, Tractors, Airplanes, Motor Boats, and Motorcycles.*

arnsdall First Refiner

CHICAGO · NEW YORK · S.T. LOUIS · KANSAS CITY · ST. PAUL LOS ANGELES

When writing BARNSDALL REFINERIES, INC., *please mention The Petroleum Engineer*

Problems of

Modern Motor Lubrication

By B. H. LINCOLN* and L. L. DAVIS**

IN designing machines the frictional surfaces are calculated to operate the majority of the time with flooded lubrication in which a thick layer of oil separates the metal and no friction between metal and metal occurs. In practice this condition is never accomplished due to starting and stopping the machine and due to known and unknown abnormalities in the machine operation.

If all automobiles could be operated at all times at their optimum designed condition, they would last much longer than the present life of the average automobile. In service an automobile must be operated at widely varying speeds, loads, temperatures and for varying lengths of time. At the extremes of these varying conditions, normal conditions of operation as to lubrication cannot be attained, which many times give conditions of "thin film lubrication." Under this condition, with an ordinary lubricating oil, the friction encountered causes wear which materially shortens the serviceable life of the automobile.

Combining the knowledge of "thin film lubrication" obtained from the practical lubricating engineer and the theoretical experimenter in the laboratory, we can draw some rather definite conclusions on the subject; however, it is thoroughly realized that there is yet much to be learned. M. D. Hersey[1] in discussing "thin film lubrication" states, "While continuous efforts must be devoted by research laboratories to the solution of thin-film-lubrication problems, notably oiliness, wear and seizure, practical engineering design should be directed toward the maintenance of thick film lubrication." The problem is an active one with the designer of automobiles, as well as with the lubricating oil producer.

* Assistant to Manufacturing Manager, Continental Oil Company.
** Supervisor Process Division, Continental Oil Company.
[1] Mechanical Engineering—Vol. 52, No. 8, August, 1930, page 772.

Theoretical and practical data compiled during the last thirty-five years proves that in thin film lubrication oiliness of the lubricant is the major factor (assuming proper and acceptable design). The term oiliness has been defined "as the property of lubricants by virtue of which one fluid gives a lower coefficient of friction than another fluid of the same viscosity, generally occurring at low speeds or high loads." The property referred to was known to be a particular characteristic of fatty oils for many years, but its isolation and identification remained for the researches of Wells and Southcombe.[2] These researchers found that as little as two per cent of commercial fatty acid lowered the coefficient of friction of mineral oils to the coefficient obtained on the straight fatty oils. These results were of such importance that Wells and Southcombe obtained patents in twenty-eight different countries. These results have been confirmed many times since the initial discovery. The results obtained by L. Archbutt on the Thurston friction testing machine will serve as an example.

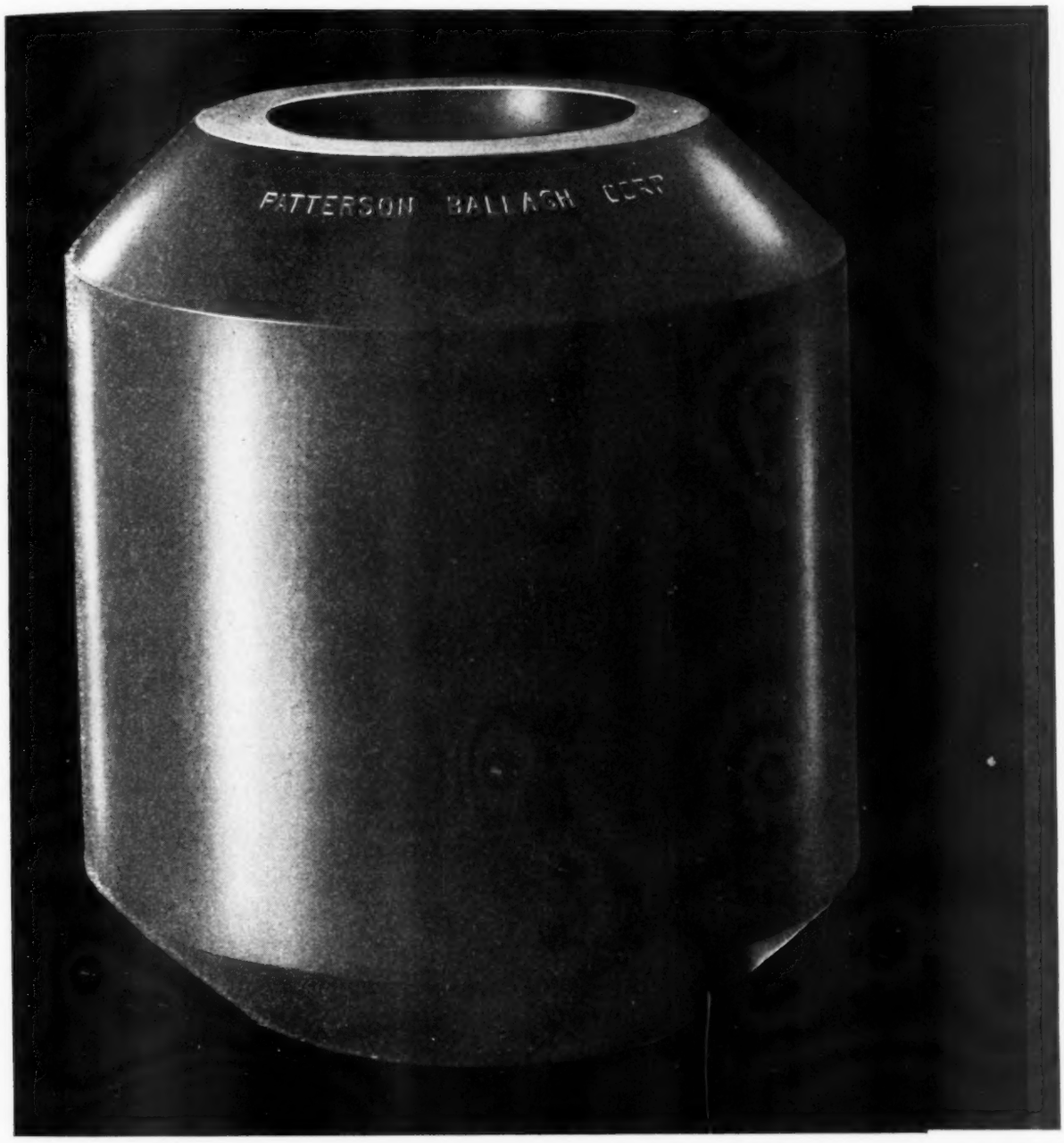
The Thurston machine was operated at a speed of 7 feet per minute and a load of about 270 pounds per square inch, and the following results were obtained:

	Mineral Oil	Fatty Acid	Coefficient of Friction
1.	100%	0%	0.0066
2.	99.5%	0.5%	0.0049
3.	99%	1.00%	0.0045
4.	98%	2.00%	0.0042
5.	100%	0%	0.0066

Following this series of tests it was decided to determine the coefficient of the fatty oil from which the fatty acid

[2] Journal of the Society of Chemical Industry—Vol. 39, No. 5, March 15, 1920, page 51.

Aerial view of Continental Oil Co.'s Wichita Falls refinery—Courtesy Texas Flying Service, Inc.



FULLY PAT-ENTED

STABILIZERS

If used in stovepipe casing the Stabilizer will practically eliminate trouble from collapsing or a broken seat.

Under ordinary conditions dropped drill pipe, equipped with Stabilizers, will float to the bottom —avoiding serious trouble.

Bettis Stabilizers on the drill pipe in open formation and Bettis Protectors on the pipe within the casing guarantee 100% protection against excessive friction. They are a necessity in every rotary drilling well. Ask for Catalog.

PATTERSON-BALLAGH CORP.
Insurance Exchange Building, Los Angeles
Texas and Gulf Coast Distributors:
BETTIS SALES CO., 917 Merchants & Mfrs. Bldg., Houston
Oklahoma Distributors:
BAILEY & BECKER COMPANY, 410 Thompson Bldg., Tulsa
New York Office: 39 Cortlandt Street
Carried in stock at Los Angeles, Ventura, Kettleman Hills, Bakersfield, Coalinga and Long Beach, California; Tulsa and Oklahoma City, Oklahoma; Houston, Texas; Hobbs, N. M.; Calgary, Alberta, Canada; New York City.

When writing PATTERSON-BALLAGH CORP. *please mention The Petroleum Engineer*

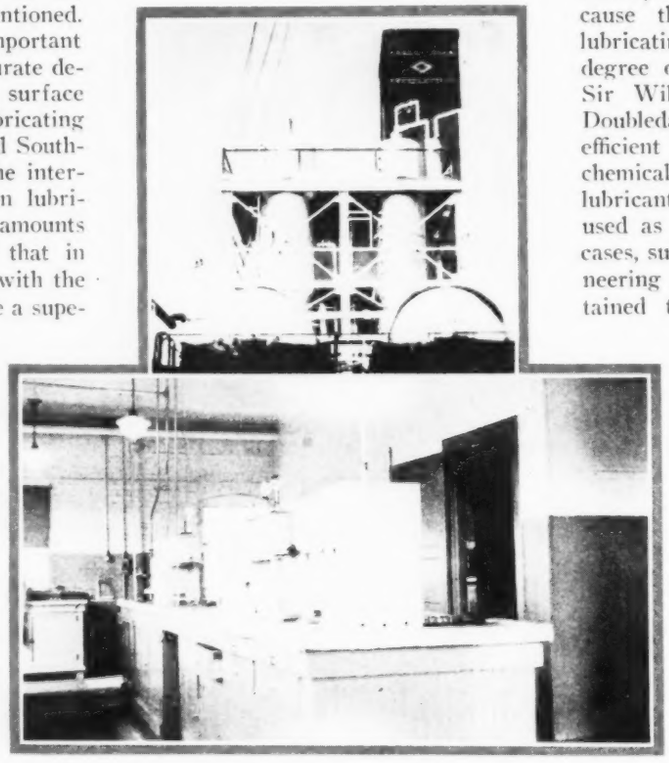
came. The fatty oil was freed of its fatty acid and blended with the same mineral oil shown above.

	Mineral Oil	Neutral Fatty Oil	Coefficient of Friction
1.	100%	0%	0.0066
2.	90%	10%	0.0065
3	80%	20%	0.0062
4.	60%	40%	0.0052
5.	40%	60%	0.0047
6.	20%	80%	0.0041
7.	0%	100%	0.0043
8.	100%	0%	0.0062

Results as convincing as the above have been obtained in practical operation.

With the conclusive evidence obtained it is logical to ask why such small amounts of fatty acid in the best lubricating oils will cause as much as 30 per cent reduction in the coefficient of friction. To answer this question with all available data would take more space than allowed in this short article; however, some of the contributing factors can be mentioned.

Surface tension plays an important role in lubrication, but an accurate determination of the interfacial surface tension between metal and lubricating oil cannot be made. Wells and Southcombe found a lowering of the interfacial surface tension between lubricating oil and water by small amounts of fatty acid and concluded that in actual use the lubricating oil with the lower surface tension would be a superior oil. This conclusion was confirmed by friction testing machines and by practical application. Wells and Southcombe did not conclude that any substance which lowered the interfacial tension would give similar results. Wilson and Barnard[3] compared fatty acid of the process with p-cresol in lubricating oil against mercury and found that both substances lowered the surface tension, but the p-cresol increased the coefficient of friction while the fatty acid materially lowered it. "Wetting" obtained with a lubricating oil depends on the surface tension of the oil.[4] The lower the surface tension, the greater the "wetting". If a globule of mercury is placed on a clean sheet of metal, it retains its globular form and does not wet the metal. If on the same piece of metal we drop a globule of fatty acid, it immediately loses its globular form, spreads over the surface of the metal and we have a good example of "wetting".



Upper—Gesoline recovery plant. Lower—Laboratory at Glenrock, Wyoming, refinery of Continental Oil Co.

For a substance to lower the coefficient of friction it must do more than lower the surface tension. It must have the property of forming a solid rather than a fluid film, and must be of colloidal rather than of ordinary molecular dimensions.

Colloidal chemistry points to the fact that heavy lubricating oils must be included in the category of iso-colloids, i. e., polyphase systems in which the disperse component is of the same chemical nature as the dispersion medium. Just as water must be regarded as a system in which molecules such as $(H_2O)_3$ coexist with simple H_2O molecules; so in a lubricating oil the disperse phase is a molecular aggregate suspended in a dispersion medium of simpler and similar structure. It is certain that this conception materially assists our efforts to explain the high viscosity, the large temperature-coefficient of viscosity and the hysteresis effect which have been observed in heavy oils. The high coefficient may be due to two causes:[3] (a) the increasing dispersity of the disperse phase; (b) the lowering of the interfacial tension. With the principles of colloid chemistry many characteristics of lubricants may be readily understood, but the effect of fatty acids used in the "Germ Process" may be partly considered independently of these principles.

Chemical Constitution.—Knowledge of the chemical constitution of lubricants is, at best, very meager and unsatisfactory. This fact is regrettable, because the many characteristics of lubricating oil depend to an exceptional degree on the chemical constitution. Sir William Hardy and Miss Ida Doubleday[5] have determined the coefficient of static friction of pure chemical substances when used as lubricants. The chemical substances used as lubricants were not, in most cases, such as would be found in engineering practice, but the results obtained throw considerable light on chemical constitution and lubrication. Only pure paraffin hydrocarbons, their alcohols and acids were used. The coefficients were determined by placing a spherical slider on a plane surface. From the middle of the slider a short stem projected from which a fine thread passed over a light pulley to a light pan for holding weights. Weights were added until the slider just moved. From the weight of the slider and the weight of the pan the coefficient of static friction may be obtained.

$$\frac{\text{Weight of Pan.}}{\text{Weight of Slider.}}$$

Every precaution was taken to obtain perfectly clean surfaces and the experiments were conducted in a closed chamber through which a current of purified air was passed. The coefficients of friction shown in Table 1 for each of the three classes of compounds used need no particular explanation. (The smaller the number for coefficient of friction, the less the friction.)

The chemical composition of the plate has considerable effect on the resulting friction, but we shall not go into the subject at this time. From the table it is noted that the coefficient of friction decreases with an increasing number of carbon atoms in each of the classes of compounds. (Bismuth on bismuth with the alcohols as lubricants shows erratic results). Comparing C_8 compounds of each of the three classes under the caption "Steel on Steel" points out one relation of lubrication to chemical constitution.

[3] J. I. E. C.—Vol. 14, No. 8, August, 1922, page 691.
[4] Mech. World 8—326-327 (1927).
[5] Proc. Roy. Soc. A. c (1922), pages 550-74; A-CI (1922), pages 487-492; A-CIV (1923), pages 25-38.

A YEAR ago Link-Belt Company's reputation as the foremost builder of fine power transmission chains was tremendously advanced by the offering of SS-40 Hyper and SS-124 Hyper Rotary Chains. They were immediately acclaimed the best and most successful chains for oil field service.

Now out of an experience which has produced our original fine line of Hyper Chains, and which has built and marketed hundreds of thousands of feet of successful oil country chains used in every country in the world where oil is produced, comes a new and improved Rotary Chain, sharing in and benefiting by all that has contributed to the remarkable success of our original Hyper Chains.

The Link-Belt Company presents in the new Drop Forged Sidebar SS-124 Hyper Chain, new elements of value in Strength, Performance, Convenience and Reliability.

Folder No. 1249 contains complete specifications. Send for a copy today.

LINK-BELT COMPANY
Leading Manufacturers of Positive Driving Equipment
200 S. BELMONT AVENUE INDIANAPOLIS, IND., U.S.A.

4100

LINK-BELT

When writing LINK-BELT COMPANY *please mention The Petroleum Engineer*

Paraffin—Steel on Steel—C_8 Coefficient of friction 0.4112
Alcohol—Steel on Steel—C_8 Coefficient of friction 0.2981
Acids —Steel on Steel—C_8 Coefficient of friction 0.2003

From these results we can conclude that the greater the affinity of the active end of the aliphatic molecule, the greater the lowering of coefficient of friction. This confirms the statement of Dallwitz and Wegener [6], "lubricating power depends on the force with which the oil is absorbed by the metal." Oleic acid, C_{18}, used in the process would show a lower coefficient of friction than C_{12}, Dodecoic acid, which has the lowest friction coefficient shown in Table 1.

With recent absorption theories we can throw some light on this physico chemical force of attraction of the lubricant for the metallic surface. We know there is a secondary valence with alcohols and acids, and that the surface of an absorber is the seat of a field of force due to the residual valences of the atoms on the surface. Absorption consists in saturating the residual valences of the surface and the secondary valence of the molecules.

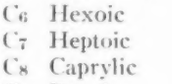
As in other absorption processes, there is a measurable heat effect occurring on absorption which is usually called the "heat of wetting". Bachmann and Brieger [7] have measured this heat of wetting. These investigators took three classes of oils.

1. Oils of evident lubricating power.
2. Poor lubricating oils.
3. Germ Processed oils according to Wells and Southcombe.

By the use of oils processed in this manner a permanent "oiliness" film is formed on the frictional surfaces. Ample evidence is available from many sources to prove that the permanent film is formed and lowers the friction as much as 30 per cent during periods of boundary lubrication—particularly at low speeds, high loads, during starting and stopping the engine, and at any time abnormal operation is obtained in the engine. A little information on the subject is briefly reviewed here, but possibly the greatest proof available is from actual operation of automobiles. A number of automobiles have been driven relatively long distances with dry crankcases, during which time the engines have been perfectly protected by the permanent "oiliness" film.

TABLE No. 1

PARAFFINS

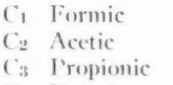


Lubricants		Coef. of Friction Glass on Glass	Coef. of Friction Steel on Steel	Coef. of Friction Bismuth on Bismuth
C_5	N-Pentane	0.7102	0.4763	.....
C_6	N-Hexane	0.6908	0.4528	0.370
C_7	N-Heptane	0.6751	0.4307	0.346
C_8	N-Octane	0.6552	0.4112	0.320
C_{11}	Undecane	0.5903	0.3421	.....
C_{19}	Nonodecane	0.4119	0.1785	.....
C_{24}	Tetracosane	0.3251	.....	.....

ALCOHOLS

Lubricants		Coef. of Friction Glass on Glass	Coef. of Friction Steel on Steel	Coef. of Friction Bismuth on Bismuth
C_1	Methyl	0.6772	0.4610	0.29
C_2	Ethyl	0.6512	0.4418	0.32
C_3	Propyl	0.6301	0.4173	0.34
C_4	Butyl	0.6061	0.3924	0.30
C_5	Amyl	0.5854	0.3752	0.27
C_8	Octyl	0.5176	0.2981	0.25
C_{11}	Undecylic	0.4455	0.2298	.....
C_{16}	Cetyl	0.3253	0.1143	0.17

ACIDS



C_1	Formic	0.6823	.....	0.45
C_2	Acetic	0.6003	.....	0.40
C_3	Propionic	0.6387	.....	0.31
C_4	Butyric	0.5721	.....	.....
C_5	Valerianic	0.5259	.....	0.28
C_6	Hexoic	0.4654	0.3108	.....
C_7	Heptoic	0.4051	0.2556	.....
C_8	Caprylic	0.3417	0.2003	0.19
C_{10}	Decoic	0.2006	0.0741	.....
C_{12}	Dodecoic	0.0983	.....	.....

[6] Petroleum Zeit. 16—250.
[7] Kolloid Zeit. 36 A—142-154 (1925).

Loading rack at the Glenrock plant of The Continental Oil Co.

Tanks at the new Continental refinery at Denver, Colo.

TABLE No. 2

RELATION OF HEAT OF WETTING TO LUBRICATING POWER

OIL.	Temperature Rise/20 per Grams Cu with Benzol °C	Temperature Rise/20 per Grams Cu with Benzol °C.	Heat of Wetting per 100 Grams Cu °C.
Castor oil	0.018	.....	11.75
	.019	.....	12.40
Linseed oil	.023	.....	14.40
	.021	.....	13.25
Machine oil distillate	.022	.....	14.55
	.021	.....	14.00
Refined machine oil	.010	.....	6.65
	.099	.....	5.95
Paraffin oil	.006	.....	3.85
	.006	.....	3.85
Petroleum	.....	0.007	5.3
	.....	.008	6.0
Benzol	.....	.003	.....
	.....	.004	.....
Petroleum with 1% oleic acid	.....	.029	22.0
	.....	.027	20.5

NATIONAL SEPARATORS

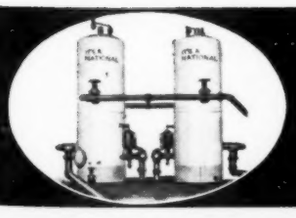
WE are sure that the long tested and thoroughly approved principles of design incorporated in National Separators are the basis of the most efficient performance obtainable through the use of any separator built.

Our challenge to you is this—compare the actual performance of Nationals with that of other make Separators on the market!

We claim:

1. Highest possible percentage of oil and gas separation by actual test.
2. Lowest cost—when satisfactory performance is considered.
3. No grief from faulty construction or inefficiency of new untried and unproven features.

Our New Catalog Will Soon be Ready for Distribution. May We Put Your Name on the List to Receive One?



NATIONAL TANK CO.

TULSA OKLAHOMA

When writing NATIONAL TANK CO. *please mention The Petroleum Engineer*

Activity Increasing *in* Eastborough Field

Top to bottom—A standard rig—A rotary well—A field scene, all at Eastborough.

THE Eastborough field, on the east outskirts of Wichita, in Sedgwick County, Kansas, has become the most active field in the Sunflower State from the standpoint of drilling. There are nearly thirty drilling wells in this new pool at this time.

The producing area, which is yet undefined, offers possibilities of crude oil production in two different horizons. The upper of these is the chat stratum of the Mississippi formations and the lower is the Wilcox sand, or second break in the Mississippi lime.

The field has become particularly active since the discovery of Wilcox sand production. This formation is found in the district at 3,240 feet. Only a few wells have, as yet, been completed in this formation. The completed wells have made close to 1,500 barrels each daily.

The majority of completions have been finished in the chat horizon, which is found from 2,940 to 2,950 feet in depth. These wells have an initial production of 25 barrels in the south portion of the pool to 400 barrels on the north end.

Wells in the Eastborough field are being drilled with both standard and rotary tools. The standard or cable tools are generally used in boring the holes for chat producers, but there are some Wilcox sand tests being drilled with this type of tools. The early drilling in the field, due to it seeking chat production, was with cable tools and rotaries have only recently made their appearance among the standard rigs that dot the horizon.

General drilling conditions in the pool are practically the same as those encountered in other fields of central Kansas, which is to say that drilling is comparatively easy going.

In the chat wells, where standard tools are used, the casing program has called for the setting of surface pipe, which is 15½-inch casing, at slightly above 100 feet beneath the surface. The next casing point, which is for the 12½-inch casing, is around 850 to 875 feet, while the 10-inch pipe is cemented slightly below 1,900 feet. The eight and one-quarter-inch size string is set anywhere from 2600 to 2750 feet. The hole is finished up with six and five-eighths-inch diameter pipe, or occasionally with a liner of the same size, that is set on top of the chat formation.

The casing program for rotary tests to the Wilcox sand is very simple. Only one string is generally set in addition to the surface pipe. It is of eight and one-quarter-inch size set above the Wilcox sand. An indication of the comparatively easy drilling is shown by the fact that most of the rotary tests reach that formation in about thirty days. This includes spudding, setting of pipe and bringing the well into production.

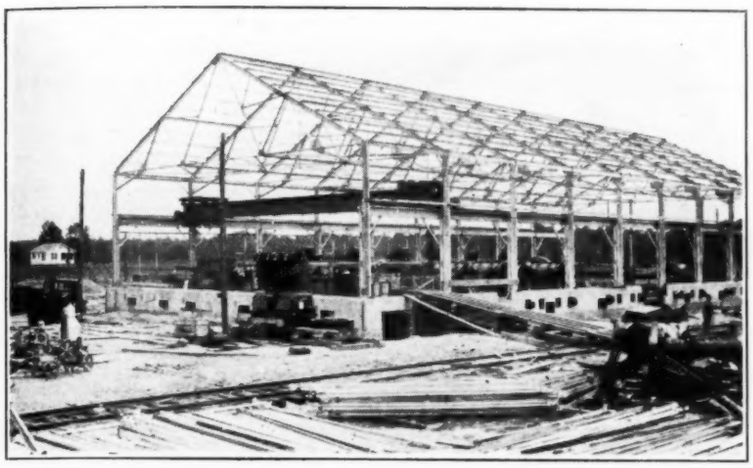
The structure of the field is typical of this part of Kansas. The surface represents a slightly raised rolling dome. The formations encountered to the chat horizon are identical with other areas of this part. However, above the Wilcox sand the formations have been punched up until there is practically no Viola lime horizon present above the Wilcox sand.

The west and north end of the pool have a number of townlot leases, and if production pans out, there may be an increase in the amount of drilling in the field.

PRACTICAL FIELD METHODS

Make Quick Work of

PIPE LINE CONSTRUCTION



ANY TYPE OF CONSTRUCTION

River Crossing Compressor Stations
Pipe Line Construction of any type
- - - anywhere. » » » » »

The Natural Gas Engineering Corporation is composed of men whose long experience qualifies them for any type of construction. » »

NATURAL GAS ENGINEERING CORP.

PIPE LINE CONSTRUCTION

Thos. R. Weymouth, President

GENERAL OFFICES:
Oklahoma Natural Building ❖ ❖ ❖ Box 2047
TULSA, OKLAHOMA

Robt. W. Hendee, Vice-President

When writing Natural Gas Engineering Corp. *please mention The Petroleum Engineer*

Handling High Voltage *in*

By L. M. GULLESEN, *Chief Electrician,*

WITH the advent of the induction motor and centrifugal pump for pipe line use, it soon became evident that in order to obtain maximum efficiency, it would be preferable to use 2,300 volt motors.

Most electricians have, long ago, realized that from a safety as well as a durability standpoint, all wiring and equipment of this type should be, as far as possible, enclosed in metal and all conduits, control boxes and motor frames, thoroughly grounded.

Our company has found by experience that a fire wall between the pump and engine room is the safest type of building to use for Diesel engine installation.

The modern induction motor might be installed and operated safely in the same room with the pumps, but as it was found necessary to provide a separate room for the control apparatus, it was decided to include the motor inasmuch as this simplified the arrangement of the apparatus.

About two years ago, it was decided to install a main line booster station. The equipment consisted of four 250 horse-power, 3,600 R. P. M., 2,300 volt, three-phase, induction motors, each motor being direct connected to a six-inch, three-stage, centrifugal pump known as a half unit. On this installation, however, they were to be used singly or in parallel, each unit handling about 30,000 barrels at 350 pounds pressure. This being a main line station, it was decided to install the power service wire underground. This service lead consisted of one hundred feet of No. 0000, three-conductor, cambric and lead covered cable. This cable was installed in a three-inch conduit from top of pole to inside of building and terminated in potheads of the combination clamping ring, stuffing box and conduit coupling type. The pothead terminal in the building was installed inside of a 10-inch by 24-inch by 36-inch steel cabinet.

The leads to each unit were run in 1½-inch conduits, from this cabinet, making a complete steel-clad job, with no wiring or live parts exposed. Each motor frame, compensator, oil switch and all conduits were grounded.

The only auxiliary equipment installed at this station was a one-inch centrifugal sump pump, direct driven by a one horse-power, 110 volt, single-phase motor operated from the lighting circuit. This motor was automatically controlled by a float switch installed on the sump tank which was located underground outside of the building.

The lighting was furnished by a three K. V. A. transformer located on the pole outside of the building. The arrangement of the apparatus is shown in sketch, Figure No. 1. The compensators were manually operated and each compensator was equipped with an ammeter. A 200-ampere oil switch, totally enclosed, conduit-connected type, was installed ahead of each compensator. The lighting units were of the vapor-proof type and all lighting circuits were controlled by safety switches mounted on the wall in the motor and control room. A rubber switchboard mat, extending the full length of the building, was placed in front of all compensators and motors. The motor room was

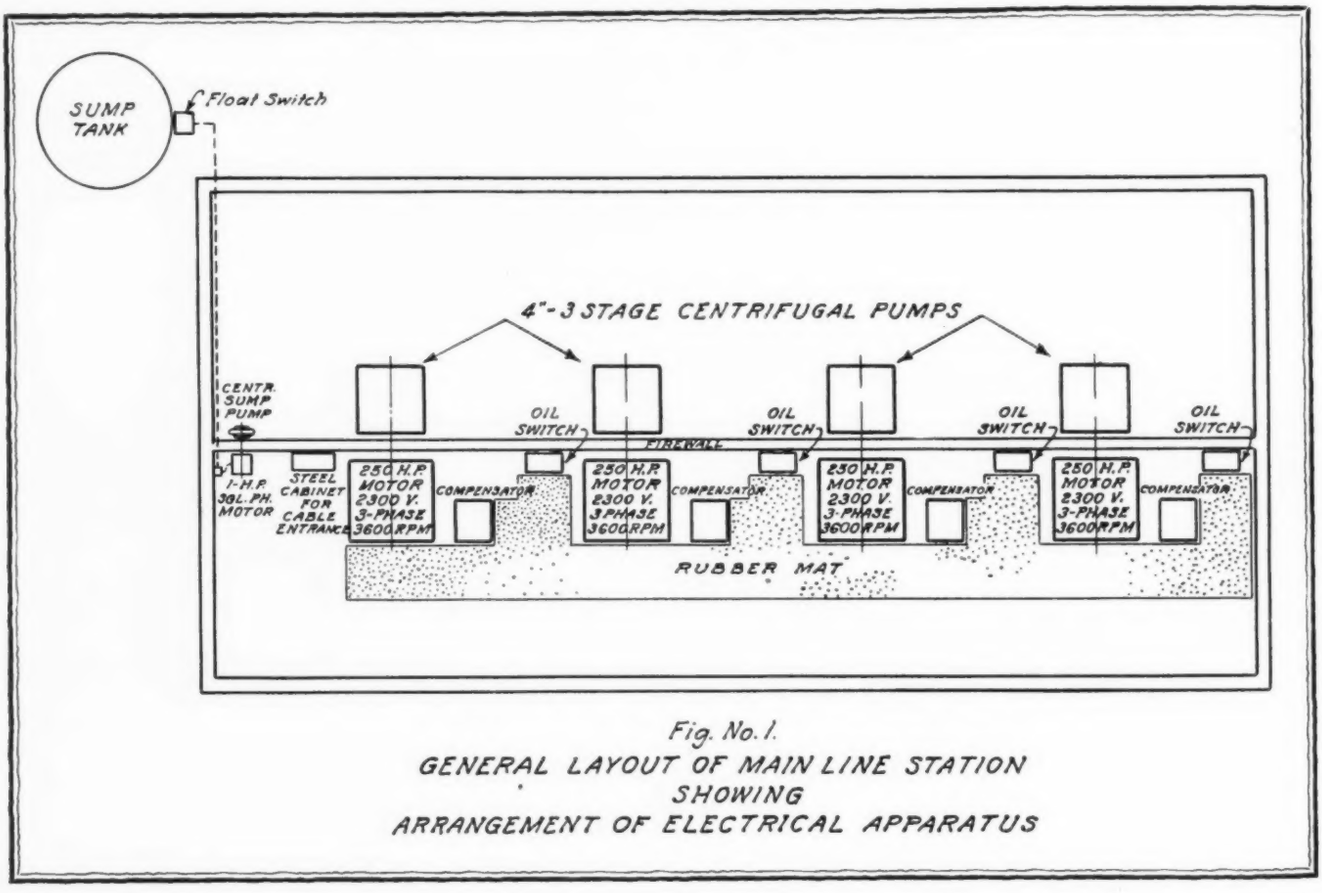


Fig. No. 1.
GENERAL LAYOUT OF MAIN LINE STATION SHOWING ARRANGEMENT OF ELECTRICAL APPARATUS

Pipe Line Pumping Stations

The Prairie Pipe Line Company

equipped with two one-gallon carbon-tetrachloride fire extinguishers.

The underground power service lead was installed because at the time of erection, it was thought that this station would remain in service over a long period of time. On gathering stations that are frequently dismantled, moved and re-erected in a new location, it has been found from the standpoint of salvage as well as labor, to be more economical to use overhead service leads. One of the factors in favor of motor-operated stations is the small buildings required for the former. This has resulted in comparatively low structures, making it impractical to fasten the service wires directly to the building. We have found that by setting a pole about two feet from the building wall and installing the service wires in conduit from the top of this pole down to a level at which we wish to enter the building and through a ninety-degree elbow directly into the junction box inside of the motor room that we have a better installation comparable in safety to the underground service.

The layout for gathering stations is essentially the same as the station already described. A word might be said about portability of gathering stations of this type.

Our company installed one station in the Oklahoma City field last year consisting of two half units. This station was erected in four days. By careful dismantling and strict adherence to the same foundation plan, the electrical work in this station when re-erected can be done in six hours by one man.

At another gathering station installed about a year ago in a Kansas field, it was necessary to install a suction pump. The equipment at this station consists of two 150 horse-power motors, each driving a three-inch, three-stage, 3,600 R. P. M., centrifugal pump. In addition to this, we installed a 10 horse-power, 220 volt, three-phase, linestart motor, driving a 5x10 suction pump. This is a reciprocating pump and is equipped with a pinion shaft extending through the firewall and is belt driven. (See Sketch, Figure No. 2.)

A good deal could be said as to the relative merits of hand-operated and magnetic push-button-operated compensators, but as this article was intended to cover installation methods only, I shall confine it to the statement that the hand compensators which we have used in all of our gathering line installations have proved entirely satisfactory, even with unskilled attendants operating them.

It is, of course, obvious to most electricians that a good conduit job properly installed is the safest method of construction and with 2,300 volt apparatus in crude oil pumping stations, sometimes handled by inexperienced operators, the best is none too good.

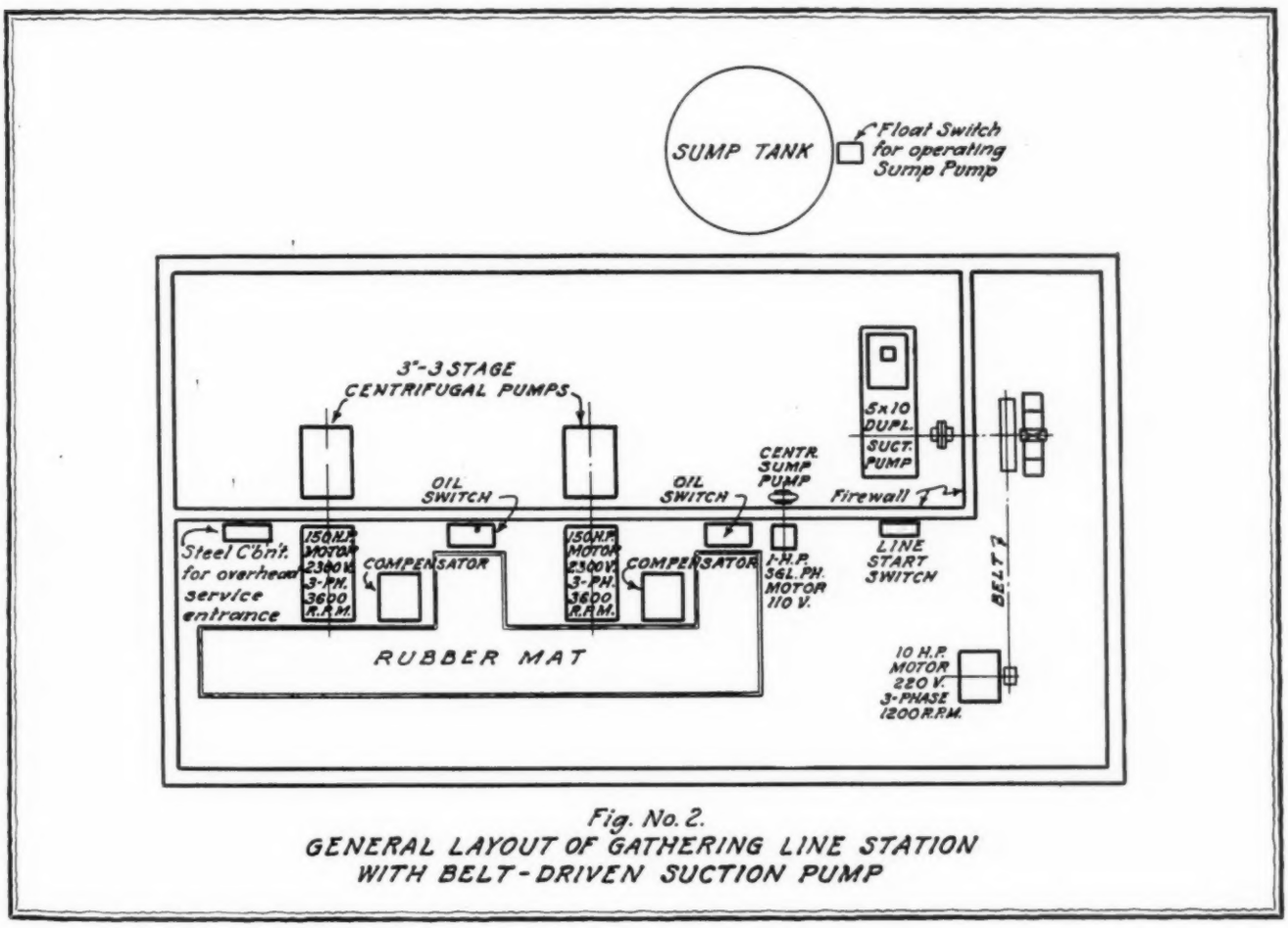


Fig. No. 2.
GENERAL LAYOUT OF GATHERING LINE STATION WITH BELT-DRIVEN SUCTION PUMP

SEE THESE EXHIBITS IN AND CONTINENTAL BUILDING AT

The Youngstown Sheet and Tube Company
A Miniature Pipe Mill in Operation

Emsco Derrick and Equipment Company
Complete Rotary Drilling Equipment

Fairbanks, Morse & Company
Diesel Oil Engine and Twin Cylinder Gas Engine

Gardner-Denver Company
New Pump, Drilling Engine, Etc.

Farrar & Trefts, Inc.
New Super Heater Boiler

D + B Pump and Supply Co.
Sucker Rods, Pumps, Etc.

Westcott Valve Company
Valves

Mechanical Rubber Company
Rough Rider Belting, Etc.

Goodall Semi-Metallic Hose and Manufacturing Company
Rotary Hose

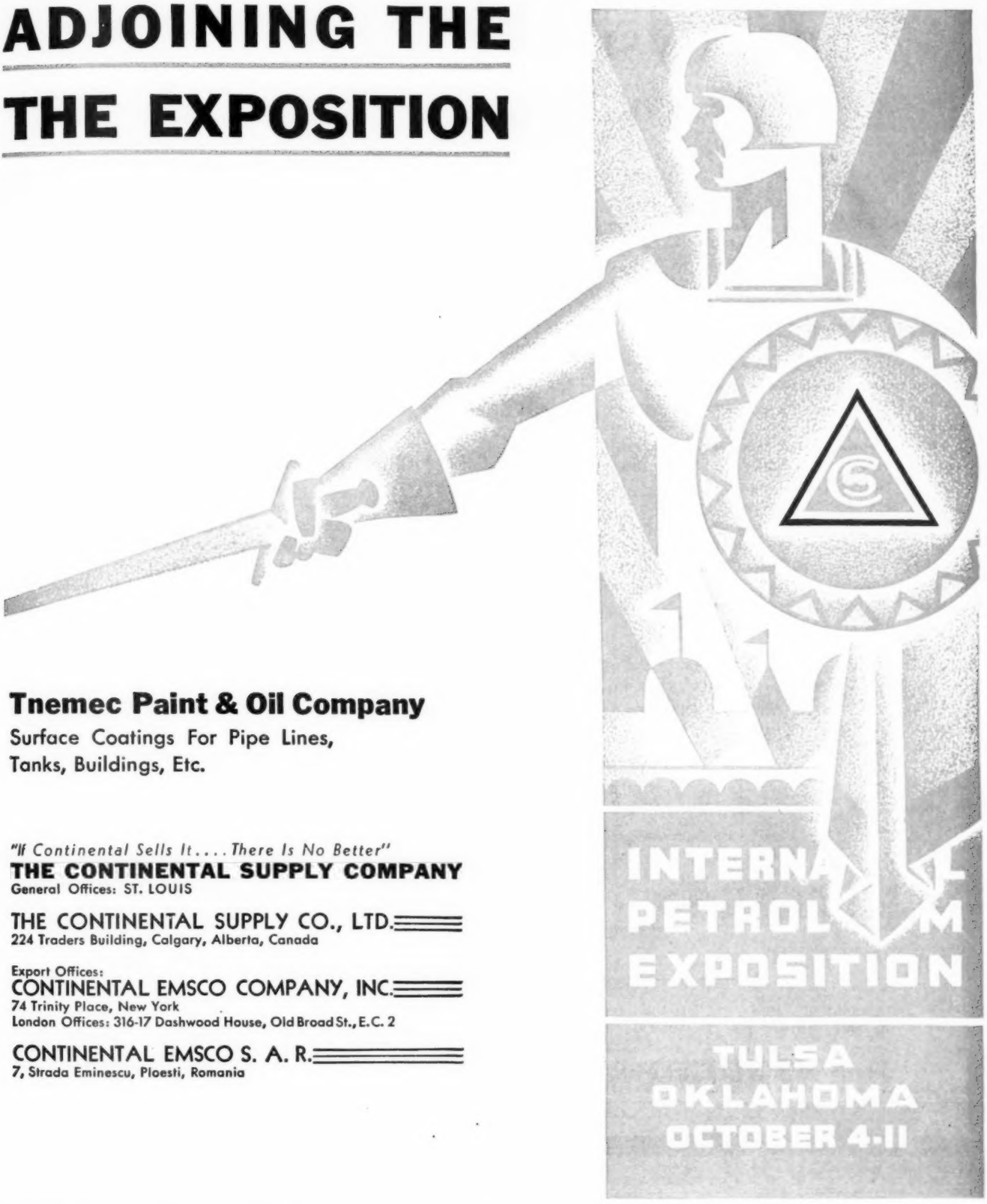
Grinnell Company
Fittings

New Bedford Cordage Co.
Cat Lines, Bull Ropes, Etc.

CONTIN

ADJOINING THE

THE EXPOSITION



Tnemec Paint & Oil Company
Surface Coatings For Pipe Lines,
Tanks, Buildings, Etc.

"If Continental Sells It.... There Is No Better"
THE CONTINENTAL SUPPLY COMPANY
General Offices: ST. LOUIS

THE CONTINENTAL SUPPLY CO., LTD.
224 Traders Building, Calgary, Alberta, Canada

Export Offices:
CONTINENTAL EMSCO COMPANY, INC.
74 Trinity Place, New York
London Offices: 316-17 Dashwood House, Old Broad St., E.C. 2

CONTINENTAL EMSCO S. A. R.
7, Strada Eminescu, Ploesti, Romania

ENTAL

When writing THE CONTINENTAL SUPPLY CO. *please mention The Petroleum Engineer*

The Physical Considerations *of* Pressure Control

By LOUIS H. BRENDEL,*

PRESSURE is the important motivating force in all gasoline plant and refinery processes. With each new refinement in fractionation or cracking comes new demands for exactness in pressure control. Progressive plant designers forge ahead with improved processes depending largely upon the ability of pressure regulator manufacturers to keep step with them.

In order to obtain a complete picture of the subject of Regulation, or Pressure Control, it will be necessary for us to review certain known basic truths. The reader's tolerance is implored through such elementary informative paragraphs as may be deemed worthwhile to insure proper continuity.

Louis H. Brendel

Since pressure is a physical force, let us review this phenomena from the standpoint of physics. We know that all matter is composed of vibrating particles, infinitely small in size, called molecules. In a gas, these molecules are spaced a great distance apart and are vibrating at a high rate of speed. As these particles of gas fly about in space they impinge upon one another and also upon the inner walls of the container within which they are confined. Because of the large number of these molecules and their high rate of speed, they constantly hit the side walls in an effort to expand within the container. This cumulative bombardment is the force we measure as pressure, usually in pounds per inch. If we crowd more particles into the same volume, the greater number of molecules now batter outwardly against the container walls and increase the internal pressure.

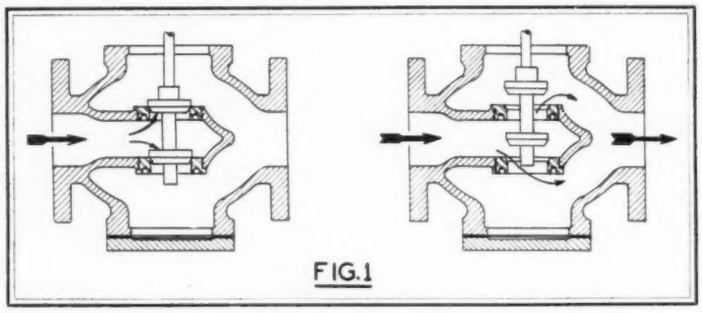


FIG. 1

In the science of regulation we are commonly guilty of thinking of everything in terms of pressure rather than considering what actually occurs. Namely, that the opening of a pressure regulator permits the closely compressed gas molecules in a vessel or pipe line to escape through it to the low or downstream side wherein the particles are less conjested.

From Boyle's Law we recall that there is a definite proven relation between volume and pressure. This law states that at a constant temperature the volume of a perfect gas is inversely proportional to its absolute pressure. For example 100 cubic feet of gas at 200 pounds absolute pressure become 200 cubic feet if the absolute pressure is reduced to 100 pounds. Were we to apply the above law without careful consideration of the effect of temperature upon the volume of a perfect gas as stated in Charles' Law our assumptions would be incorrect. This fundamental law of physics states that the volume of a gas under a constant pressure is directly proportional to the absolute temperature. For example, 100 cubic feet of gas at 300 pounds pressure at 70 degree F. would become 218.8 cubic feet of gas if the temperature is increased to 700 degrees F. The temperature effects are becoming daily more important in the newer high temperature refinery processes.

To a greater or lesser degree, however, we feel the importance of the combination of both Boyle's and Charles' Laws in all pressure control calculations.

In these notes a regulator will be considered as any device which mechanically maintains one fixed pressure condition regardless of whether the other is constant or variable. Pressure controllers, or regulators, are divided into two main classifications, namely, those that reduce a higher pressure to a desired constant lower pressure and those that maintain a set back pressure by permitting the excess pressure to escape. The latter designation includes all relief valves. Practically all types of regulating valves and equipment are included in these two major divisions. Regulators are further classified into direct acting and pilot actuated types. The first type has a diaphragm or piston directly connected to the regulator valve plug and held in position by weights, springs, mercury columns, compressed air chambers, differential pressures, or combination of these. The controlled pressure exerts its force against the diaphragm or piston so as to oppose the resistance of the weights or springs and operates the regulator valve so as to maintain the desired pressure.

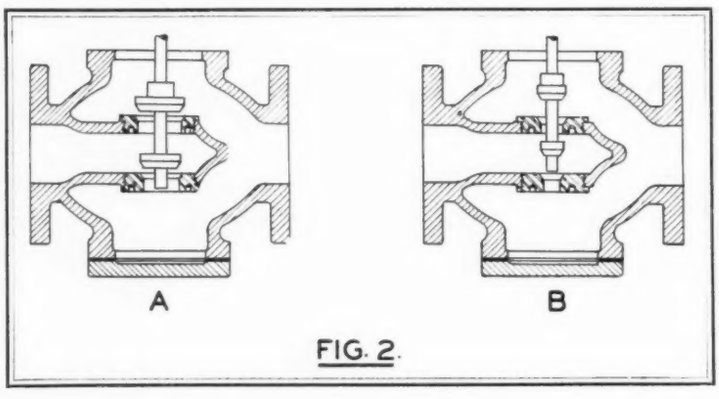


FIG. 2.

The pilot actuated type is a trifle more complex in that the main diaphragm depends upon the pilot valve to supply it with the operating medium. Such regulators may derive their operating power either from the line pressure they are controlling or depend upon an external source of gas, air, or water which motivates the main regulator diaphragm in a direct rela-

*Neilan Co., Ltd.

OF AMERICA

It is scarcely necessary to extend again an invitation to oil men to make The Exchange National Bank of Tulsa headquarters during the Exposition. For more than 20 years oil men have gravitated to The Exchange National Bank when occasion brought them to Tulsa. This is only natural, for The Exchange National is an institution conceived and directed for the specific purpose of serving the oil industry.

It has developed facilities of unusual value to the industry. It has established and maintains extensive files of information for its customers. Service is the keystone of its banking policy. It has never discriminated between individuals or institutions. And its directorate is composed of practical oil men, whose chief interest is the health and prosperity of the industry and who are keenly alert to the industry's problems.

The Exchange National Bank has become the banking institution through which most major oil transactions clear - - - because The Exchange National has been courageous and aggressive in serving the oil industry. And in performing this function it has become an international banking force - - - The Oil Bank of America.

Combined Capital, Surplus and Undivided Profits Exceed $10,000,000
Resources Exceed $100,000,000

EXCHANGE BANKS OF TULSA

The Exchange National Bank | Exchange Trust Company | Exchange National Company

D I R E C T O R S

E. I. HANLON, President, Heneghan and Hanlon, Inc.
FRANK W. BRYANT, Vice-President, The Exchange National Bank
C. B. PETERS, President, Peters Petroleum Corporation
W. A. BROWNLEE, Executive Vice-President, The Exchange National Bank
T. A. CREEKMORE, President, Summit Drilling Company
E. B. REESER, President, Barnsdall Corporation
H. V. FOSTER, President, Indian Territoy Illuminating Oil Company
THOMAS CHESTNUT, President, Chestnut and Smith Corporation
J. C. DENTON, Vice-President, Mid-Continent Petroleum Corporation
JOHNSON D. HILL, Executive Vice-President, Atlas Life Insurance Company
ROBT. E. ADAMS, Real Estate and Investments
NED HOLMAN, Vice-President, The Exchange National Bank
JOS. R. McGRAW, President, McGraw Oil Company
H. L. STANDEVEN, Executive Vice-President and Trust Officer, Exchange Trust Company
H. C. ASHBY, President, Dickey, Ashby, Fountain Company
W. C. FRANKLIN, Oil and Investments
CHAS. E. BUSH, General Counsel, The Exchange National Bank and Exchange Trust Co.
J. S. PEARCE, Pearce, Porter and Martin

When writing EXCHANGE BANKS OF TULSA *please mention The Petroleum Engineer*

tion to the amount of this medium that is supplied by the pilot valve.

One truth must be appreciated in order to understand clearly the science of regulation. It is this: There can be no flow of fluid through any line without a drop in pressure in the direction of the movement. In this respect gas flow is analogous to electrical transmission which relies upon a drop in voltage to force it over the conductor. Failure to grasp this simple fundamental will prevent a clear understanding of all pressure regulation. Practically, this means that even though a regulator valve may be fully open there will be no flow through the regulator if the upstream pressure is the same as the downstream pressure.

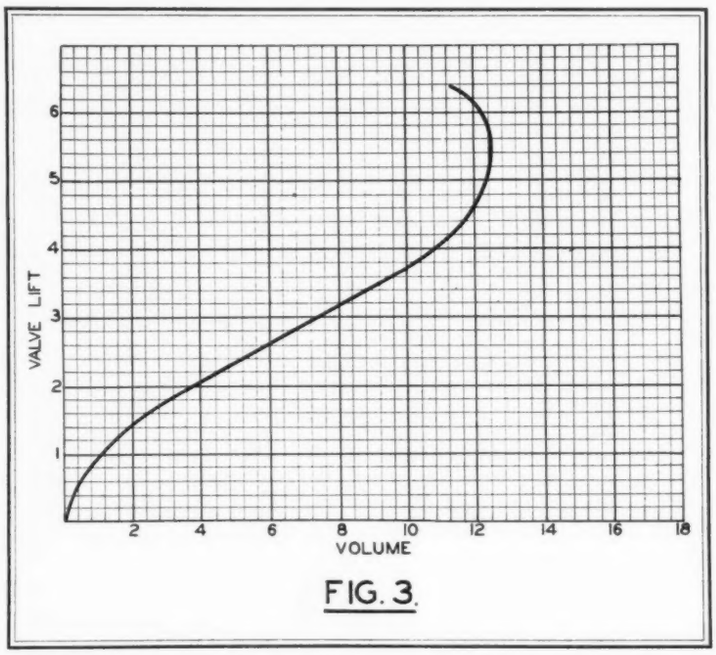
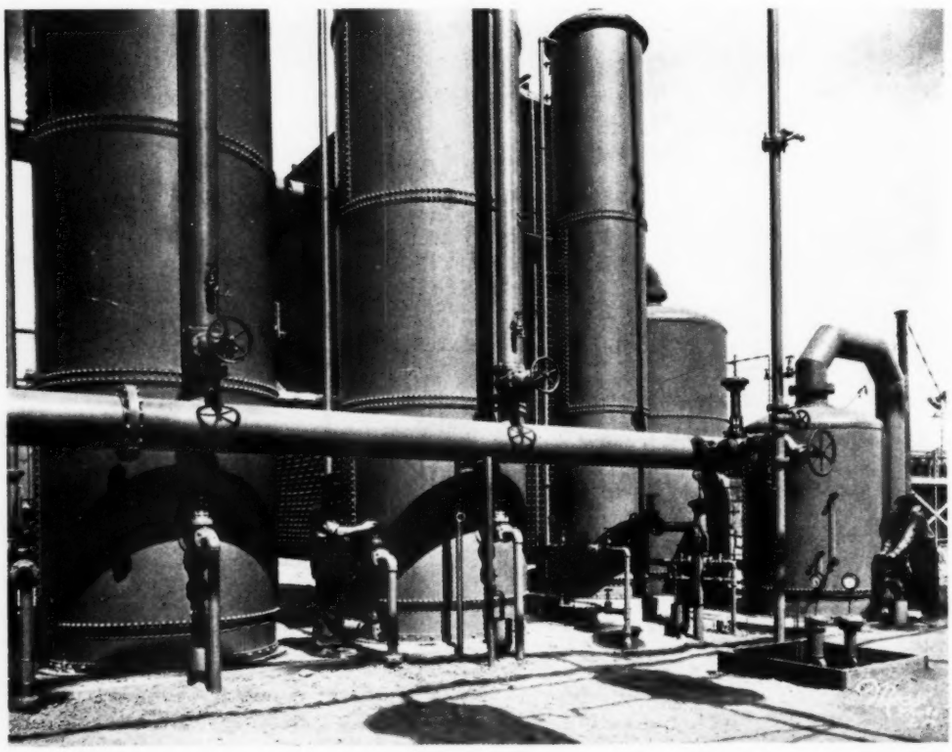


FIG. 3.

A review of the problems and service calls encountered by any manufacturer of regulation equipment over a period of years will verify how often a consideration of this fact would have eliminated the so-called "grief." It is a common occurrence for plant engineers to change this or that operating condition after the erection of a new plant. The record book of a regulator "trouble shooter" discloses that one of the popular causes for his trips is as follows: A back pressure valve (either direct acting or pilot type) is not passing as much gas as it is desired to put through it. Almost universally a careful inquiry uncovers the fact that the regulator was recommended and installed for another set of conditions than those present at the time of the visit. Usually the downstream pressure has been increased to within such close limits that there is not enough "head" to force all the volume through that the regulator formerly handled. In many instances the pressures have been such that the volume required to pass through the regulator would not have passed through the pipe alone, even if there had been no regulator in the line. As a guide on this, any table of gas or liquid flows through orifices at various pressures will provide a helpful check. Obviously a line in which is installed a regulator, even with the valve in a wide open position, can never pass a greater volume than the same pipe without a regulator.

Looking further we observe another truth which is frequently overlooked in the consideration of regulators; that a regulator in service with a high upstream pressure and a small pressure drop will often pass the same volume of gas as the same regulator having a large pressure drop through it, but a relatively low upstream pressure. For example: Two regulators of the same size will pass approximately the same volume of gas; one with an upstream pressure of 250 pounds and a 10 pound pressure drop, the other with 100 pounds upstream pressure and a 90 pound drop. The lack of appreciation of this inherent fact causes many to find the subject of regulation more mystifying than they should.

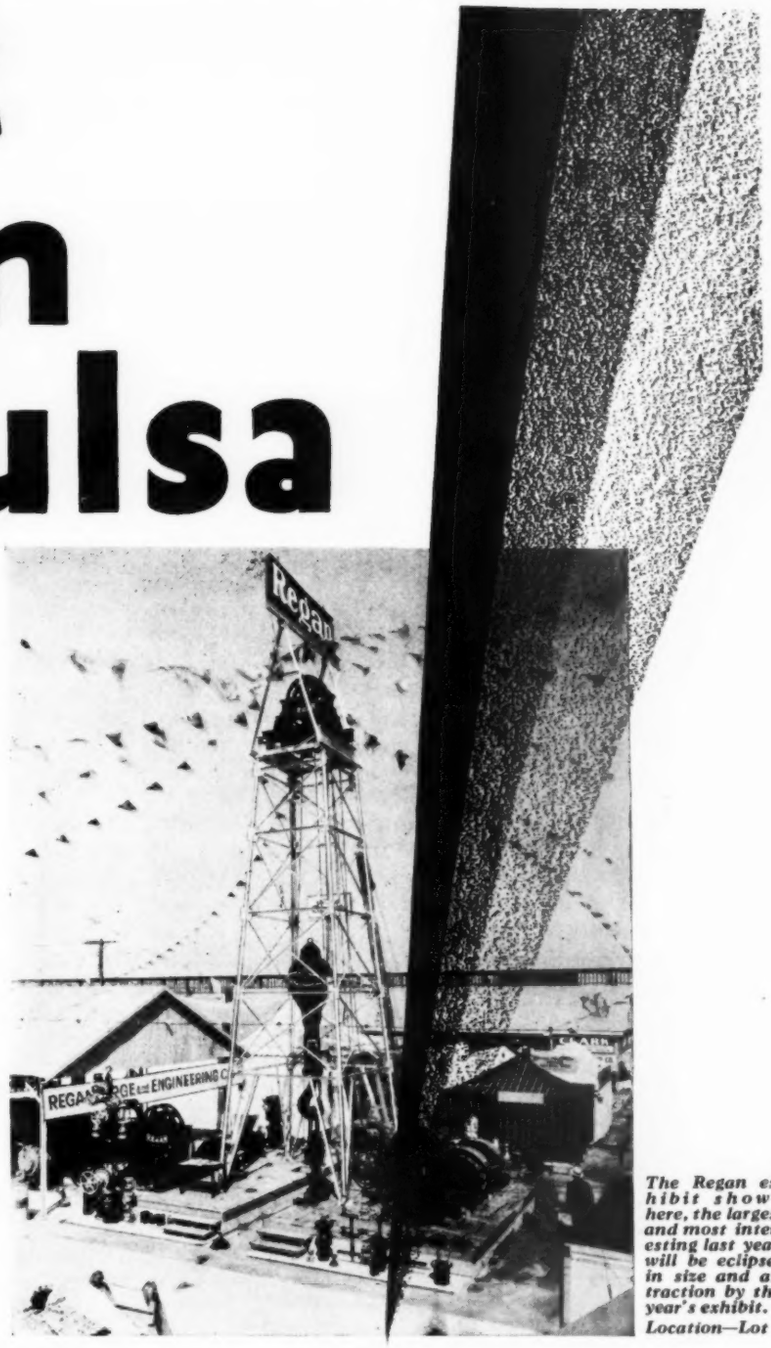
The physical behavior of these gas molecules while pass-



View of a California natural gasoline plant.

meet Regan at Tulsa

Bringing to the Tulsa Exposition the latest types of drilling and control equipment Regan again presents the outstanding exhibit. Several new devices will be shown for the first time and are expected to create a sensation among drillers and production men. Don't miss the "hot spot" of the entire show—the Regan Exhibit. It's worth traveling across the continent to see.



The Regan exhibit shown here, the largest and most interesting last year, will be eclipsed in size and attraction by this year's exhibit. Location—Lot E

Regan
Forge & Engineering Co.
Oil Field Equipment
Plant and General Offices:
SAN PEDRO (Los Angeles Harbor) CALIFORNIA, U. S. A.

New York Office
75 West Street
Wm. Braat, Manager

Mid-Continent Office
Dallas, Texas
501-2 Marvin Building

Representatives
Oklahoma City, Okla.
2420 W. 21st St.

Pecos, Texas
P. O. Box 444

Maracaibo, Venezuela
Wm. Adams,
care Amer. Consul

PREMIERE SHOWING OF NEW EQUIPMENT

Regan Tubing Gas Controller
Regan Adjustable Tubing Head
Regan 6-Sheave Traveling Block
Regan 9-Sheave Crown Block
Regan Snubbing Device

NEW 1931 CATALOGS READY FOR DISTRIBUTION

When writing REGAN FORGE & ENGINEERING CO. *please mention The Petroleum Engineer*

ing through the regulator valve body will now be analyzed insofar as it influences the body design. Just as the naval architect is confronted with the conflicting demands for high speed, heavy armament and heavy armor plate, just so is the regulator valve body designer opposed by the conflicting factors of port area, coefficient of contraction and valve lift. If he concedes to one he must sacrifice the others. The best he can hope for is a compromise based fundamentally on mathematical calculations made practical by numerous empirical flow tests and formulae.

The first known constant to be considered in the design of a body is the pipe area. It is assumed that all readers have long appreciated the fact that double ported, or valves in which the inlet pressure tending to force the upper valve seat open and the lower valve seat closed are practically balanced, are widely used in a regulator service. The first variable to be determined is the size of the valve ports to be used. Figure 1: Consider gas under pressure on inlet side with valve closed. As soon as the valve is opened, the molecules expand upward through the top port and downward through the bottom port with a velocity depending directly on how great a pressure drop is present. The retarding effect of a 90-degree elbow in a pipe line is known. A similar retarding effect on the gas is experienced due to the change in flow direction necessary in passing through the two ports. Theoretically it would appear that if the sum of the areas of the two valve ports were equal to the pipe area the valve would, when sufficiently opened, pass the full pipe capacity. Here again the designer is torn between opposing demands; (1) by using large valve ports (Fig. 2-A) the full pipe capacity may be passed by lifting the valve plug only a small distance, however, this same feature increases wire drawing severely and makes it impossible to get close regulation with widely varying volumes, (2) on the other hand, if relatively small ports are used, (Fig. 2-B) wire drawing is greatly reduced but the valve plug must open much more, which is mechanically difficult. Perhaps we may find the physical phenomena of wire drawing worthy of closer scrutiny. The term is clearly descriptive of the result, in which the valve plug and valve seat rings appear to have had a wire drawn through surfaces before they had hardened. It takes but a mild case of wire drawing to render a valve unsuitable for tight shut-off. The results of this process are quite similar to the natural erosion of the earth's surface. Wire drawing is caused by infinite numbers of fluid molecules rubbing across the face of the valve plug and seat rings. Two conditions are necessary to produce this phenomena and the more pronounced these conditions become, the more destructive is the wire drawing. The first requirement is a constricted area through which the molecules flow, the other requisite is a pressure drop from one side of the valve to the other. The former brings a greater number of erosive particles in contact with the restricting surfaces. High pressure drop through a valve means that the molecules have an exceptionally great velocity as they rush through the valve, expanding in volume as they go. This velocity effect is really the major cause of wire drawing although it is not greatly felt, except in passing through constricted passages. The relation of the total area of both ports to the pipe area,

$$\frac{\text{sum of both port areas}}{\text{pipe area}}$$

is called the coefficient of expansion of the valve body. The velocity of the gas after just passing through the ports is limited by the volume of the space directly above and below the top and bottom valve discs. From this larger volume the gas passes through a constricted space and into the downstream or outlet pipe line. In this operation the body maker utilizes the coefficient of contraction,

$$\frac{\text{constricted area cross section.}}{\text{pipe area}}$$

While these computations are valuable, it is here that the ingenuity of the designer as well as his understanding of flow peculiarities and stream-line characteristics stand him in good stead. At this period in the design of a suitable body much experimental testing must be done.

Here the need for individually designed bodies for gas, for liquid and for steam will be realized. The action of the molecules in gas and steam which are compressible is distinctly different from the molecules of a liquid which is non-compressible. Steam in a similar manner is quite different from gas in that it easily condenses to water, or, on the other hand, may by expansion, become superheated. Design engineers now use a particular type of valve body construction best suited for the fluid which is to flow through it.

Due to the above peculiarities of steam molecules when expanding and absorbing heat enough to become superheated, and to the wish to prevent an extreme frictional loss through the regulator, bodies are sometimes used with enlarged outlets to provide ample space for the expanded particles of steam.

Note the eccentricity of the flow curve in Fig. 3. This tends to disprove an erroneous belief which is heard occasionally, namely, "the greater the valve plug opening, the greater the volume flow through the valve body." The flow curve reaches a maximum at 5.5 valve lift and it would be logical to expect the curve to continue up vertically to the end of the valve plug lift. Strangely enough, however, after the plug rises beyond a certain point the flow turbulence and abnormal swirling effect set up tends to reduce the flow volume appreciably.

So much for the physical angle of the regulator itself, let us investigate how it performs one of its common physical tasks. Pressure regulators are widely used to maintain fixed pressures in absorbers by controlling the rates at which gas is admitted. A fixed orifice enables gas to leave the absorber at a definite constant rate. As long as the internal pressure remains steady the gas rate may be easily controlled by the outlet orifice. In this use we are controlling the volume by holding a desired constant pressure. The control of the oil rate is a far simpler operation since oil is non-compressible and is measured by the displacement method. The regulator has the difficult duty of admitting molecules of gas among which are particles of gasoline vapor at the same rate that the molecules of gas are escaping from the absorber. The relative rate of the oil and gas depends upon how many molecules of gasoline must be absorbed by the lean oil while the gas is in contact with the oil. Gas having a rich gasoline content naturally requires the oil circulating pump to be speeded up or the gas rate diminished.

Less attention is paid the physical characteristics of pressure regulators because they are more intangible and therefore less interesting than the mechanical. In our next article we will investigate the absorbing study of the actual construction of pressure controllers and the reasons for the mechanical decisions now in use.

Specifications of Aviation Oils

By E. R. IRWIN, *Asst. Aero Chemist,*
Material Division, U. S. Army Air Corps.

SPECIFICATIONS are a necessary evil. A past issue of The Houghton Line tells the story of the purchasing agent of a large railroad who lost patience with the poor quality goods obtained under the specifications in use. A new system was adopted whereby the man in charge of a particular department was permitted to order the materials used in his department by commercial brands which he knew to be satisfactory or superior to the usual quality. For a considerable time after the initiation of the new system, the materials were excellent, as only trade marked products of reputable producers were purchased. But as soon as all of the manufacturers who were producing the various articles used by the road and who had any influence with the persons in charge of the selection of the source of supplies, and there were many of them, discovered the possibilities of the new system a change was apparent. The final result was summed up by the purchasing agent as follows: "There is only one thing worse than buying to specifications and that is not buying to specifications."

During the past two years the author of this series of articles on aviation oils and gasolines, has done extensive research work in order to establish a relationship between laboratory tests and specifications with performance data obtained in actual flight tests. This article should be of particular interest to refiners manufacturing aviation oil.

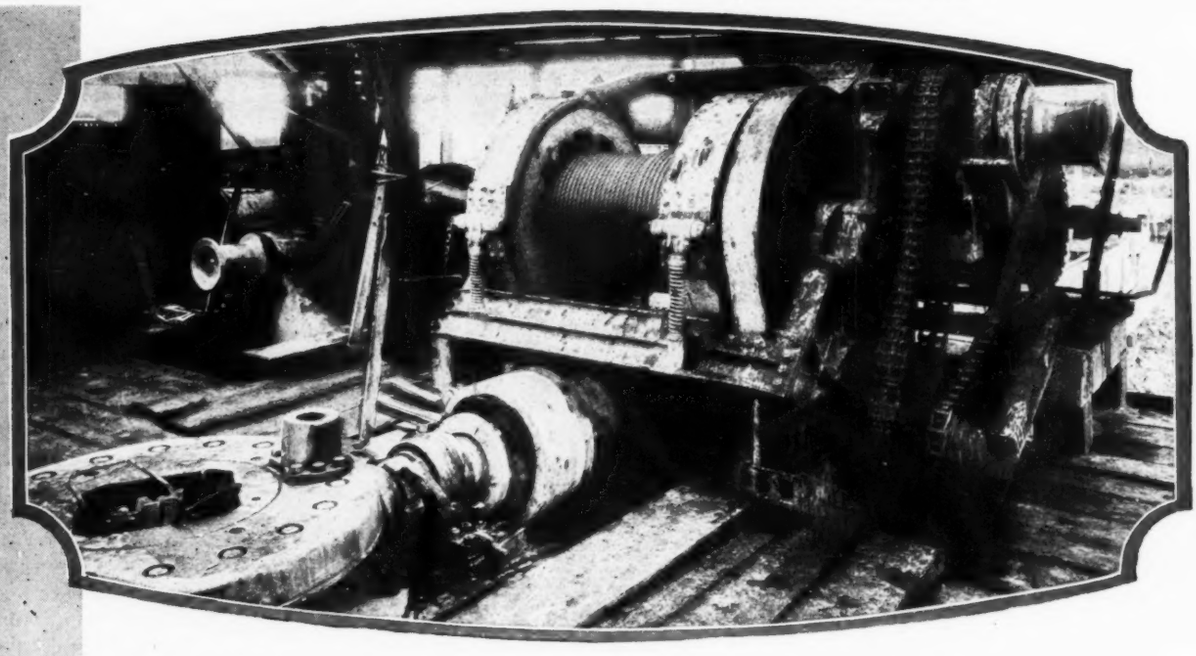
But in a larger sense specifications are not only essential, but universal. When a man buys a pair of shoes he usually has previously formulated a specification for his purchase, including size, color, material, the type of shoe her, or perhaps his wife, thinks is suitable for the desired use, and the approximate price he is willing to pay for the desired characteristics.

The general form of all specifications is similar. The viscosity specification of oil corresponds directly to the size of a pair of shoes, the pour point and flash point may be compared to the type of shoe as they indicate further the limitations as to use, while the color, carbon residue, emulsion test, etc., are comparable to workmanship. Physical analysis of petroleum products show the source and are, therefore, in the same category as the choice of the different kinds of leather. Extreme excellence in one respct dos not excuse deficiency in another. There is no more reason for using in winter a gasoline or oil of known value in summer work than there is in wearing a very fine and durable pair of house slippers in a snowstorm.

A specification, then, must cover first a material physically suitable for the use desired; second, it must describe the grade of raw material and workmanship necessary to produce a finished article of at least good commercial quality, or if the latter is not possible, it must set forth the requirements for the finished article such that only a satisfactory product will meet all the requirements. As far as possible it must admit all of the good and none of the poor quality products. However, in the event that it is not possible to construct a specification which is 100 per cent accurate, which is frequently the case, it is the privilege of the purchaser to exclude a reasonable number of good products to insure the elimination of all the undesirables. The purchaser in general should have the right to specify what he thinks he wants rather than what the manufacturer thinks he ought to want. This last postulate must be modified somewhat in the case of specifications promulgated by the Federal Government and its agencies due to the inevitable tendency of state and municipal governments and even private consumers to purchase to Federal specifications. In the case of air corps specifications this tendency is in some cases undesirable, sinve air corps specifications are influenced primarily by the conditions and requirements of military service and even if the product obtained was the very best possible it might not be particularly suitable for general commercial use.

There are three general methods of preparing specifications which will be mentioned. The simplest method might be called the identification method and consists of determining the physical or chemical characteristics of a number of satisfactory commercial products and preparing a specification based on the average values obtained for the group, allowing sufficient tolerances to cover the usual manufacturing deviations. For certain petroleum products, such as, kerosene or painters' naphtha, this method is completely satisfactory since these products is such that detail deviations in chemical composition or other difficulty established characteristics are not important. In the case of lubricants the physical characteristics do not establish the value of the material in service and the finished products defy chemical analysis. It is, therefore, necessary to go beyond the limits of identification testing to insure a satisfactory product. The viscosity, gravity, color flash point and pour test of an oil covers the practical physical constants obtainable in the laboratory and show whether or not the oil is suitable physically for certain uses. They are, of course, necessary requirements of a specification, depending on the use intended, but the specification for oil or gasoline must also include some means of judging the value in service.

The most obvious way of determining the value of an article in service is to use it in that service under carefully controlled conditions and note its performance. This method may be termed the "approved list" method, since it is usually applied by preparing a list, based on the service tests, of the known satisfactory and approved products. If and providing that the service is such that the tests can be accurately controlled and duplicated this method is highly desirable and it is widely used in the field of lubricants. The specification need consists only of very simple identification tests, since the seller is depended upon to maintain the quality of his product and the purchaser only satisfies himself that no error or substitution of grossly inferior material has been made. It is therefore very fair to the producing industry for it allows the manufacturer a wide latitude in the selection of raw materials and the characteristics of the finished goods. If at any time the material furnished



Type H Machine drilling in Louisiana using gasoline engines for power. Note reverse gear to left of machine and the chain drive to the bailing reel which is mounted back of the draw-works.

Sheldon-Burden Type H Rotary Drilling Machine

A GEAR-DRIVEN deep well rotary drilling machine with principal parts mounted on one substantial steel base to provide quick and easy moving and rigging up. Rotary table, draw-works, and steam engine or electric motor are easily removable from base and transported as separate units when desired.

Special high-speed steam engine or electric motor and gear box are mounted back of draw-works on the steel base of the machine when steam or electric power is used. When gasoline or Diesel engines are used, the reverse gear is mounted in the corner of the derrick and the chain from it is connected to the rear shaft of the machine. The engines (and double hook-up if desired) are placed on the ground or on a platform alongside of the derrick.

The rotary table is shaft-driven and controlled by a friction clutch which can be set to slip before the pipe twists off. The friction clutch can be instantaneously engaged or disengaged at any shaft speed, thus making for ease of operation and safety.

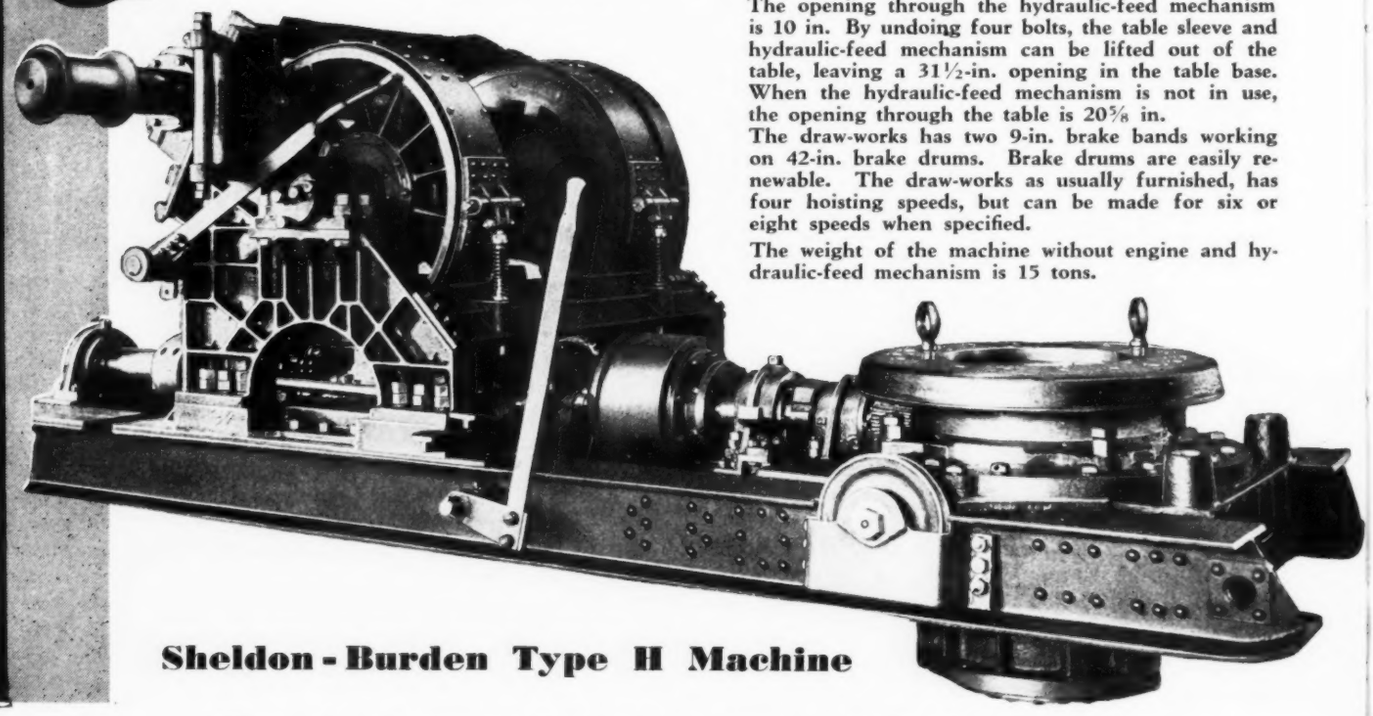
The shaft drive to the table eliminates the usual chain across the derrick floor and permits a wide range of table speeds from the slowest up to 250 r. p. m.

The rotary table may be used as a regular rotary table or with the Sheldon-Burden Type Hydraulic-Feed Mechanism.

The opening through the hydraulic-feed mechanism is 10 in. By undoing four bolts, the table sleeve and hydraulic-feed mechanism can be lifted out of the table, leaving a 31½-in. opening in the table base. When the hydraulic-feed mechanism is not in use, the opening through the table is 20⅝ in.

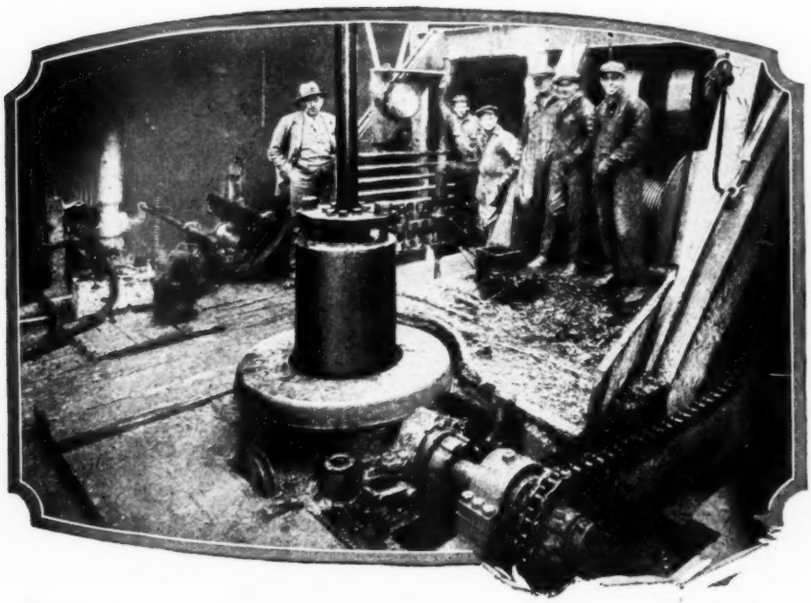
The draw-works has two 9-in. brake bands working on 42-in. brake drums. Brake drums are easily renewable. The draw-works as usually furnished, has four hoisting speeds, but can be made for six or eight speeds when specified.

The weight of the machine without engine and hydraulic-feed mechanism is 15 tons.



Sheldon-Burden Type H Machine

When writing SHELDON MACHINERY CORP. *please mention The Petroleum Engineer*



Drilling in Canada at depths of over 5,000 feet with rock bits in hard lime. Gas pressures up to 2,500 lbs. were encountered. Straight holes were drilled where other equipment was unable to complete the wells due to crooked holes, and frequent sticking of the pipe from settlings.

Sheldon-Burden Type HR Rotary Table

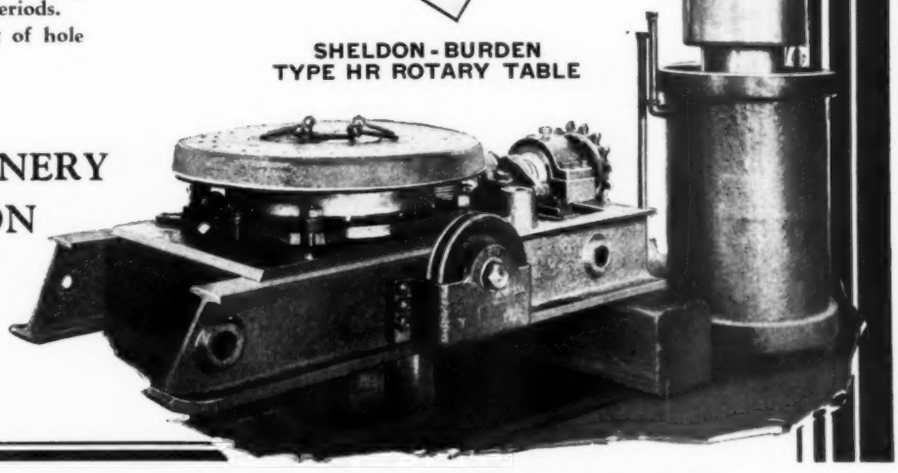
for use with any regular type draw-works and engine

TYPE "HR" Rotary Table is designed for use with any of the regular type rotary rigs. This permits you to get many of the advantages of the hydraulic-feed mechanism while still using the old type equipment. Some of the many advantages of the Sheldon-Burden Type Hydraulic-Feed Mechanism are:

(1) Drills straighter holes more easily.
(2) Can drill upward through cavings.
(3) Can press downward on the bit to make up for lack of pipe weight.
(4) Increases footage obtained from various type bits by keeping accurate and proper bit pressures.
(5) Can be used as 100-ton capacity hydraulic jack when working stuck pipe.
(6) Indicates immediately when passing from soft to hard formation or vice-versa.
(7) Is a super-sensitive and accurate weight indicator.
(8) It can keep pipe moving while making connections or in case of machinery break-down.
(9) Feeds and rotates drill pipe while working against well pressure.
(10) Micrometer feed of hydraulic-feed mechanism produces better cores with less shattering or burning.
(11) Accurate feed of drill pipe assured regardless of depths and weight of pipe.
(12) Eliminates all rotating load on swivel bearing while drilling.
(13) Increases efficiency of the driller by giving accurate feed control without his holding the brake lever for long drilling periods.
(14) Permits safe snubbing of pipe out of hole against high well pressures.

Write for this interesting book on rotary drilling

SHELDON-BURDEN TYPE HR ROTARY TABLE



SHELDON MACHINERY CORPORATION

15 Park Row, New York

Branch Office: 953 M and M Building, Houston, Texas.

Distributors: Oil Well Supply Company, Lucey Products Corporation

by a certain manufacturer fails to equal or better the material originally approved, either in service or on a repeat test, the manufacturer may be removed from the approved list. Another possible advantage of this system is that the estimated cost of the article purchased may be based not only on the unit of purchase, but also on the service to be obtained. The well-known "work factor" and approved list of lubricating oils of the Navy Department is a good example of a logical development of this method.

The Air Corps has not adopted the approved list system for oils and gasolines for the following reasons. First, the time and expense involved in the service testing of these products is tremendous and on account of the advertising value few manufacturers interested in the sale of aircraft gasoline and oil would leave any possibility exhausted in their efforts to be placed on the approved list, whether or not they had any interest in Government business. Second, the difficulties of obtaining duplicable service test data are so obvious that they will not be enumerated. Third, laboratory tests have been or are being developed for gasoline which are considered more valuable than the most accurate

which are considered more valuable than the most accurate service tests possible. In the case of oils and greases it is admitted that laboratory specifications fall short but constant improvement of the aircraft oil specification is attempted and considerable work is now in progress and projected which it is hoped will result in a practical specification without resorting to service tests except as a check on other experimental work.

A Standard Oil Co.'s amphibian plane.

If merely identifying the product as suitable for use as far as physical characteristics can be determined in the laboratory is not sufficient, and if chemical analysis is impractical, and if the "approved list" system is not considered desirable, then the specification must include one or more tests which, while not duplicating service conditions, serves as a measure of serviceability. It is highly desirable that the laboratory test be such that results are obtained in much less time than in actual service, otherwise a great deal of the advantage of eliminating the service test is lost. A very satisfactory example of such a test are the accelerated test cabinets for paint material which are rapidly eliminating the service testing of protective coatings. The aim of the Air Corps experimental work is to establish laboratory tests for oil and gasoline which will insure a satisfactory quality without the expense and time involved in service tests.

The problem of specifyin ga suitable gasoline is relatively simple and it is believed that work now accomplished and in progress will result in a very desirable laboratory specification. This specification includes the well-known A. S. T. M. distillation test, a knock-rating in the Series 30 Ethyl Gasoline knock engine, a Reid vapor pressure determination, an accelerated aging test to determine the tendency of the fuel to form gum in storage, and a copper test for corrosion only. Thus there are only four essential properties to be met; two, volatility and knock-rating, to determine the physical suitability of the fuel for use, and two, corrosion and gumming, to determine the degree of chemical stability. Not all of the limits are definitely established, but it seems certain that the specification can be drawn on the basis of the above tests with very good results and that a relatively small amount of additional work is necessary to definitely set the required values for each test. The freezing point of the fuel must also be considered, but it is not believed that any difficulty will be experienced in obtaining products satisfactory in this respect. The usual value of 0.1 per cent sulphur to eliminate corrosion of the internal parts of the engines will be retained.

Specifying a suitable oil for use in an internal combustion engine is much more difficult. The problem of obtaining a product of the proper physical characteristics can be met by specifying the viscosity at one or more temperatures, the pour point and the flash point. This assumes that either the oiliness of all mineral oils of the same viscosity is approximately the same or that the oiliness of the least oily oil is sufficient. It is considered probable that the latter assumption is more nearly correct and that engines must be so designed that a reasonably plentiful supply of oil is applied to the cylinder walls.

One requirement for the oil used by the Air Corps is that it must be satisfactory for use in either hot or cold weather, since military operations may be necessary in almost any extreme of climate and separte set of specifications for hot and cold weather are not desirable for both economic and strategic reasons. It is fortunate that the oils which are best suited to winter flying are not inferior in other respects the Air Corps specifications goes beyond their requirements. In fact, most commercial flying does not require an oil of as good quality as does military flying, due to the lower powered engines and less full throttle operations. It is not to be inferred from this statement that the oils procured by commercial aircraft operators under trade names are inferior to the specification purchases of the Air Corps. Up to the time of the adoption of Specification 3556 the reverse was certainly true. The inference intended is that the Air Corps is justified in any reasonable attempt to improve the quality of its oils for operation under severe conditions and that, because a specification should include all the essentials and no non-essentials, commercial users might obtain as good or better results with cheaper products. Much is written concerning the quality of oils for use in internal combustion motors without very much being known concerning the characteristics of the oils which indicate good quality. By good quality we mean resistance to change of properties in use, including freedom from sludge, carbon, and the various other effects of oxidation. The technical staffe of twenty-eight refiners were recently cir-

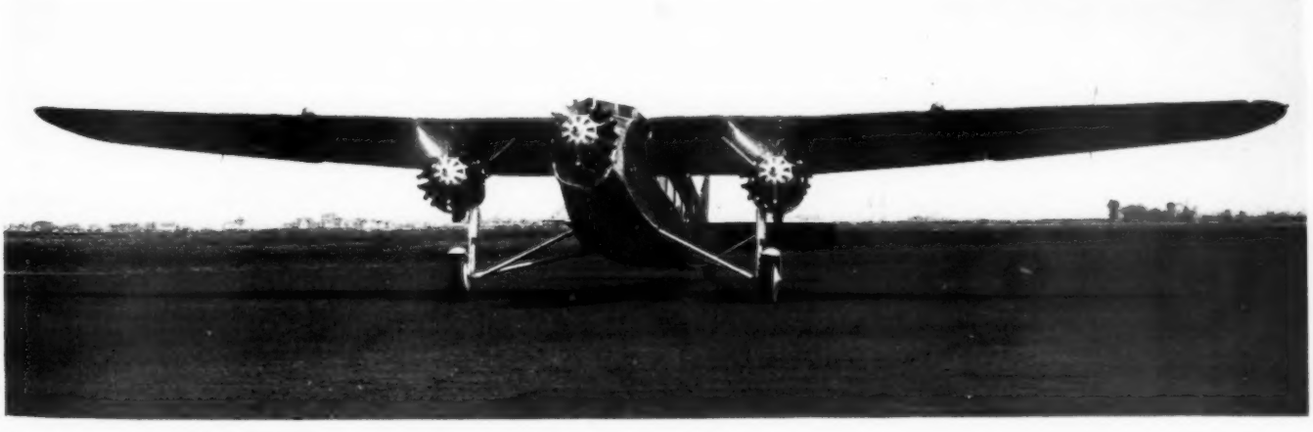
cularized, asking what tests should be included in Air Corps specification to improve it in this respect. The great majority recommended no change from the Conradson carbon residue test, some stating that the test is a very good criterion and more believing that the test is only very approximately correct, but that at present there is nothing better to substitute. For another example, the emulsion test as described in Air Corps specification has been frequently criticized by refiners whose products do not conform to its requirement. Probably their criticism is correct and their products are superior to some products passing the test. The only use the writer can see in the emulsion test is that it takes the place of a much longer series of tests dealing with various impurities which are believed to be generally undesirable.

But a specification should never be considered in piecemeal. It has been shown by one investigator or another at one or another time that practically every test which has ever been applied to lub oils is of no, or doubtful, value. The fallacy of such work lies in the fact that when one characteristic is varied other variables are almost sure to creep in and the good or poor quality of an oil may be due to the combined effect of a number of unknown factors. The test of a specification is whether or not it excludes all of the unsatisfactory products and admits a large majority of the good. Reports from the service indicate that specification 3556 has so far resulted in the procurement of oils of good quality although it must be admitted that this may be due to the integrity of the manufacturers rather than the requiremens of the specification. Some minor changes have therefore been recently made in this specification to describe a product more similar to these actually obtained by purchase and general good refiners' standards. The foregoing is not to be construed as intimating that the present specification is not subject to further investigation and revision. Any specification should be changed whenever new developments either in the service requirements or in the producing industry indicate that it would be desirable.

During the past year the Material Division has conducted about forty oil tests in a single cylinder engine. The indications of these tests are that any oil meeting the specification will probably be found satisfactory, but two of the oils which did not meet the specification ranked well up in freedom from carbon and gum forming tendency. Only commercially marketed oils have been examined in these tests and it is felt that they are representative. The need for an additional "quality tst" to indicate the relative breaking down of oils in the engine is very keenly felt. The tests used at present are indicative and provide that no serious trouble will be encountered due to an inferior quality oil, but no quantitative or even relative rating as to quality is found possible. Some of the oils meeting the specification are excellent and some only fair. It is true that there are a number of tests available which are considered by the majority of technologists to be better than the Conradson test. These include the British Air Ministry oxidation test, the Sligh oxidation test, and the Navy work test. The first named test has been examined by the Material Division and is not considered sufficiently accurate to warrant its adoption when the time required for the test is included. The Navy work test is too long for routine laboratory work and really comes under the head of service tests as the approved list system is used in conjunction with it. The Sligh test has been examined by a number of laboratories and seems to have been favorably received generally. The writer feels justified in predicting that a test will eventually be developed, if it has not been already, which will be sufficiently accurate in foretelling serviceability to use it as a basis for specification, for it must be borne in mind that service tests themselves are subject to error and the results are by no means free from question.

A specification based solely on certain arbitrary factors may be criticized on the grounds that no differentiation of quality is possible. The material either meets or does not meet the requirements of the specification, and the service cost might be lower for a high priced material when an article of cheaper price still meets the specified requirements and is purchased. But is this objection as sound as it appears at first thought? Is a gasoline of very excellent knock-rating any more serviceable than one which just fails to detonate under hte worst conditions of service, or is a fuel of extremely high volatility superior in use to one which has only sufficient volatility to be properly distributed? In the case of lubricating oils the argument has perhaps greater weight, but in specific instances fails to apply. It will probably not be contradicted that there is a certain minimum flash point for engine oils which is required and below which values are progressively undesirable, but that excessively high flash points are no great improvement. For operation in cold weather a certain pour test is required. In the factors of lubricatoin and resistance to breakdown in the engine, of course the actual relative values of the oils under consideration is more important. When more information concernin gthese qualities is available some effort should be made by consumers using the specification system to apply a cost of service rating to their purchases.

The author hopes that the material herein presented at least partially justifies the procurement of lubricating oil and gasolines to specifications based on laboratory tests.



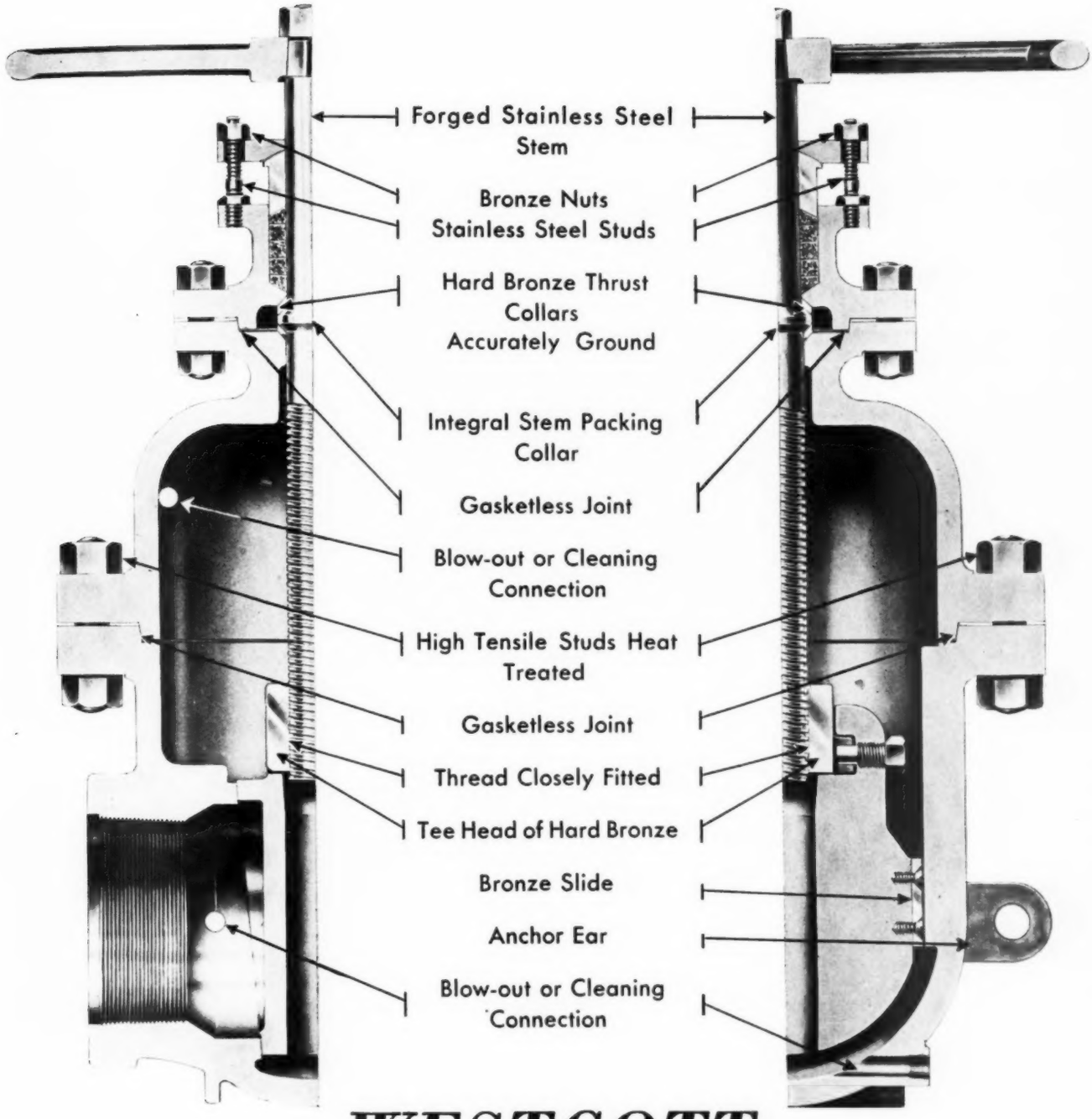
Modern trimotored plane.

No gaskets in this new valve

Leaks, blow-outs, replacements and the inconvenience caused by valve gaskets can't happen in this new Westcott Valve. Tapered, ground joints give leakless, trouble-free service and eliminate the gaskets. The full, free floating (until seated) solid wedge with bronze slides, operates with a minimum of friction along a machined steel guide in the body. See this Gasketless Valve and other Westcott Valves in the Continental Building at the Exposition.

WESTCOTT VALVES

Full stocks are carried in all stores of the Continental Supply Company and at the Westcott Valve Company, East St. Louis, Ill.



Cross Vertical Section

WESTCOTT VALVES

Longitudinal Section

Reducing Friction Losses *in* Bearings

By
JOHN M. McGREGOR*

ALTHOUGH there are many combinations of journals and bearings, most of them can be ignored for this discussion, as it is proposed only to study the requirements of such combinations that are encountered in the pipe line and compressor station and in the machine shop; however, with few exceptions these notes will be applicable to nearly every form of journal and bearing.

Any two objects when rubbed together will cause heat and to generate this heat, power is required with a resulting loss in the efficiency of the unit, and the greater the heat the greater will be the loss. Although friction losses cannot be eliminated altogether, correct design of journal and bearing and proper application of the lubricant can do much to reduce these losses.

Friction may be divided into the following three classes:

A. Sliding friction between two solid objects.
B. Rolling friction between two solid objects.
C. Fluid friction within the lubricant itself.

All surfaces, no matter how well they may be finished, are more or less rough, and the greater the pressure holding them together the greater will be the power necessary to pass the one over the other with a proportionate loss due to friction. The co-efficient of friction can be expressed in the following equation:

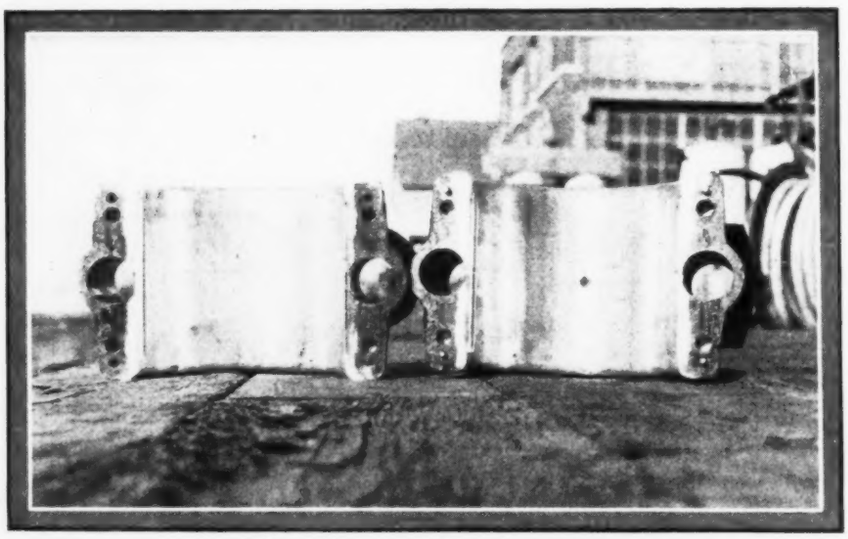
$$Fc = \frac{R}{P}$$

Where Fc = the co-efficient of friction.

Where R = maximum resistance to motion due to friction.

Where P = the force holding the two surfaces together.

When two bodies are moving in relation to each other the frictional resistance is called the friction of motion or kinetic friction. Static friction is that friction that has to be overcome to start two bodies from rest. It will be readily understood that more power is required to start the movement than is required to maintain it; consequently, static friction is in excess of kinetic friction.



A rebuilt bearing ready to be sent back to field use.

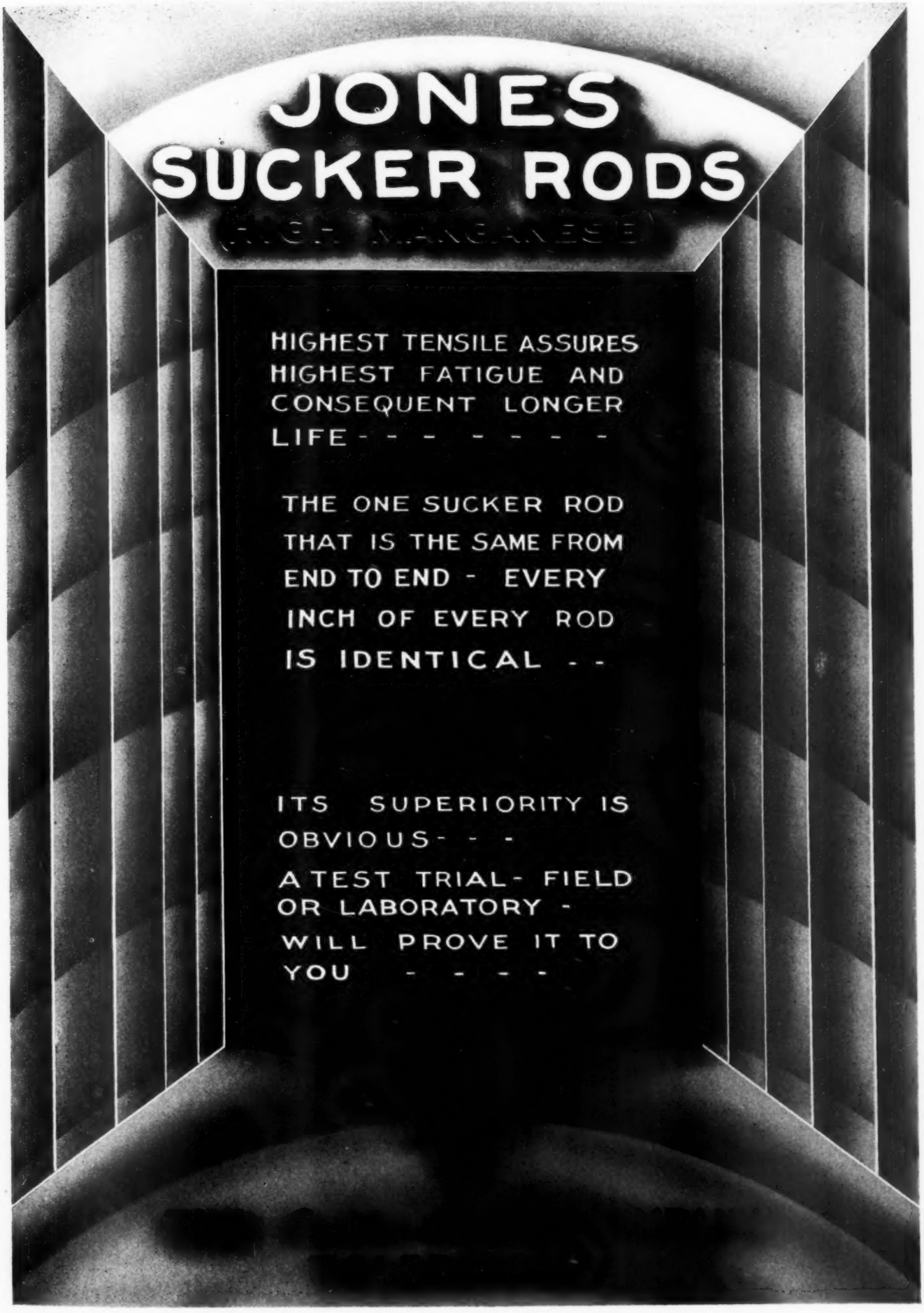
Rolling friction is that resistance offered to a cylindrical body moving over a flat or curved surface. Even with such finishes as those found in ball and roller bearings there is present a certain amount of irregularity which necessitates the moving body being lifted over the high spots and absorbing power in so doing.

Fluid friction or the friction that is set up within the lubricant itself, is of extreme importance and it is in this direction that much can be done to reduce power losses. It is difficult to realize that when a journal is rotating within its bearing the oil is divided into a series of layers which pass over each other at different speeds. Added to this there is a certain amount of friction set up within the oil itself due to the rubbing of the fluid particles, the sum of these two losses is what is known as fluid friction.

Too much stress cannot be laid on the choice of a correct lubricant to fit the needs of the machine, particularly with regard to the viscosity of the oil. Many tests have shown that the efficiency of a unit can be materially increased by the substitution of a different grade of oil. One test made recently showed that the bearings, when first examined, were running at 140 degrees F. The oil was cleaned out and an oil of the same brand but of lighter viscosity was placed in service with the result that the bearing temperature dropped twenty-five degrees. It is not known what saving in power was effected, but the very fact that such a reduction was secured meant that at least some of the loss had been eliminated, for, as has been stated already, the greater the friction the greater will be the power necessary to drive the unit. Increased temperature represented extra loss through friction and with the present-day striving for higher efficiencies in every branch of industry, any gain, no matter how small, should be secured so long as the means adopted to make the gain are not offset by the cost of so doing.

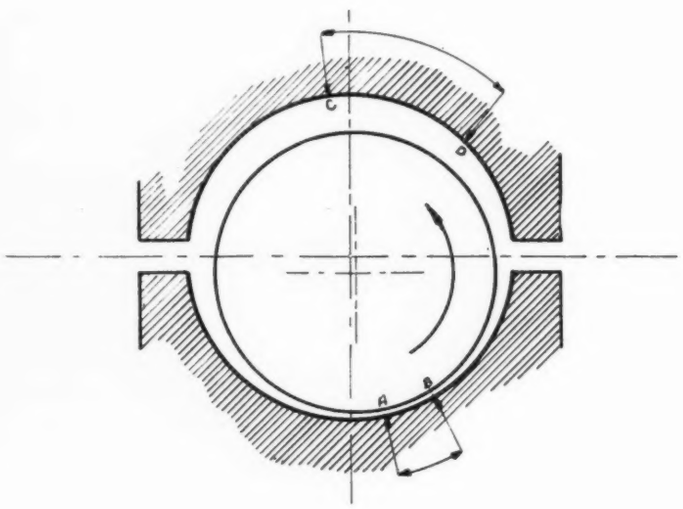
No absolute recommendation can be made as to which is the correct grade of oil to be used for so much depends on the type of machine and bearings, the pressures and the speed, but it can be said that the best oil to use, as far as viscosity is concerned, is one with just sufficient "body" to enable it to maintain a film under all the conditions to which it is subjected. Any additional viscosity will mean the consumption of more power to overcome the internal resistance of the

* Byron Jackson Co.


JONES
SUCKER RODS
(H.G.P. MANGANESE)
HIGHEST TENSILE ASSURES HIGHEST FATIGUE AND CONSEQUENT LONGER LIFE - - - - - - - -
THE ONE SUCKER ROD THAT IS THE SAME FROM END TO END - EVERY INCH OF EVERY ROD IS IDENTICAL - -
ITS SUPERIORITY IS OBVIOUS - - -
A TEST TRIAL - FIELD OR LABORATORY - WILL PROVE IT TO YOU - - - -

When writing S. M. Jones Co. *please mention The Petroleum Engineer*

SKETCH 1



JOURNAL AND BEARING EXAGGERATED CLEARANCE TO SHOW ACTION

fluid itself. When considering operating temperatures, however, the higher the operating temperature the heavier should be the oil chosen. This seems paradoxical after quoting the above test where a lighter oil lowered the temperature but in this instance the higher temperatures were caused by fluid friction. The normal operating temperatures of the bearings were low and consequently a lighter oil than that originally used was necessary if high temperatures were not to be encountered.

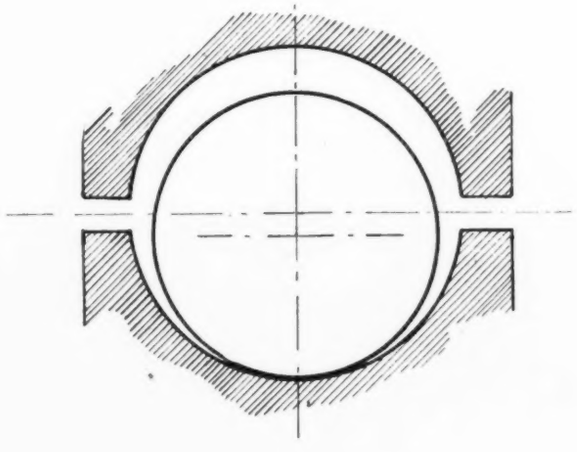
The speed of the unit is an important factor when considering the type of oil to be used. When journal speeds are high it is much easier to maintain an unbroken film, therefore when dealing with high-speed machinery a lighter oil than that used for slow speed machines may be placed in service.

Bearing pressures must also be considered. It need hardly be stated that the greater the pressure the heavier should be the oil, but care should be taken to see that at no time should one go to extremes in either direction. When it was stated that the correct oil to use is one with just sufficient viscosity to enable it to maintain a film it was also stated that this film must be maintained under all operating conditions. The fact must not be overlooked that more power is required to start the journal from rest than is required to keep it in motion, therefore, the oil used must be sufficiently heavy to withstand static friction.

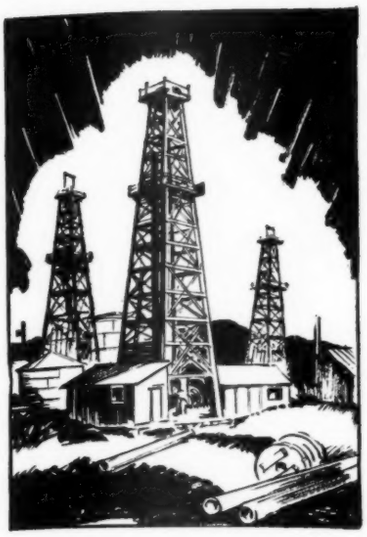
Lubrication may be defined as the introduction of some substance between rubbing surfaces to reduce frictional resistance and the resulting wear. Well-designed machinery need only be studied from the point of view of fluid friction when in motion but the loss due to partial lubrication during the time the machine is being started and stopped must also be taken into account. It is rarely possible, under ordinary operating conditions, to determine what the difference of these two losses are, but by the introduction of correct oiling methods and the use of the right oil, much can be done to lessen the losses due to friction and too rapid wear of parts.

Sketches number one and two show in greatly exaggerated form the position of the journal in relation to the bearing when the former is at rest and when in motion. Sketch two shows the journal at rest and it will be noted that it is lying on the bottom of the bearing. On starting from rest the journal has a tendency to roll up the bearing to a point where it can climb no higher and slippage occurs. As the speed of the machine increases the shaft draws the oil with it and forces it between the metal surfaces. Sketch one shows the position of the journal when it is rotating and it will be seen that the point of greatest pressure is somewhere approximating the space between "A" and "B." The position on the bearing where the pressures are lowest lies between points "C" and "D" or approximately 120 degrees from the area of

SKETCH 2



SHOWING POSITION OF SHAFT AT REST



. . . IT has been our constant aim, for over thirty years, to produce line pipe and casing of the highest quality and workmanship—and at the same time maintain the quickest and best service possible to every customer.

Trainload shipments of Chester Line Pipe and Casing are convincing evidence of Chester popularity among oil operators—a popularity which has been built on the reliability of Chester performance and Chester service under the most severe conditions.

South Chester Tube Company
CHESTER, PENNA.

Prompt Service

Prompt deliveries can be made from large stocks carried at Houston, Texas; Thenard, California; Cody and Kemmerer, Wyoming; Kevin, Montana; Paintsville, Kentucky; Charleston and Danville, W. Virginia. Ask our office nearest you for full particulars.

Chester also makes all classes of Genuine Wrought Iron Tubular Goods

CHESTER

STEEL SPECIALISTS IN CASING FOR DEEP WELL DRILLING CASING

When writing SOUTH CHESTER TUBE CO. *please mention The Petroleum Engineer*

high pressure. Many instances of bearing failure have been traced to ignorance or disregard of the correct method of applying the oil to the bearing or to the method in which the bearing has been grooved for the distribution of the oil. At no time should the oil be introduced into the bearing in the high pressure area, the correct point of entry should be within the area where lowest pressures are encountered. One would imagine that it would be unnecessary to state that the oil will not enter the bearing if the pressure behind it be less than that in the film of oil at the point of entry, yet frequently bearing failure has been traced to wrong design in this direction.

That lubrication can do much to reduce friction losses is proved by the experiments carried out by Thurston and Tower. These tests have shown that the friction of a journal per square inch of bearing surface for any given speed and rubbing velocity is equal to:

$F = kp^n v^m$

Where F = friction force at the rubbing surfaces in pounds per square inch.

k = a constant varying with the quality of the lubricant but can be taken to be 0.02 for high grade oils and 0.04 for poor grades.

p = normal pressure in pounds per square inch of bearing surface.

n = exponent depending upon the manner in which the oil is applied. Its value is 1.0 in the case of dry surfaces; 0.50 in the case of drip-feed lubrication; 0.40 in the case of ring oiling and 0 in cases where the oil is forced into the bearing under pressure sufficient to float the journal.

v = velocity of rubbing in feet per second.

m = exponent varying from 0 in the case of dry surfaces; 0.20 where drip-feed lubrication is used, and 0.50 in the case of an oil bath.

This formula shows that although the friction increases with the load on the bearing and with the velocity of rubbing, it does so at a rate much slower than either. However, the product of pressure and velocity should not exceed a certain value and this can be determined by Thurston's formula: $pv = C$

Where p = bearing pressure in pounds per square inch.

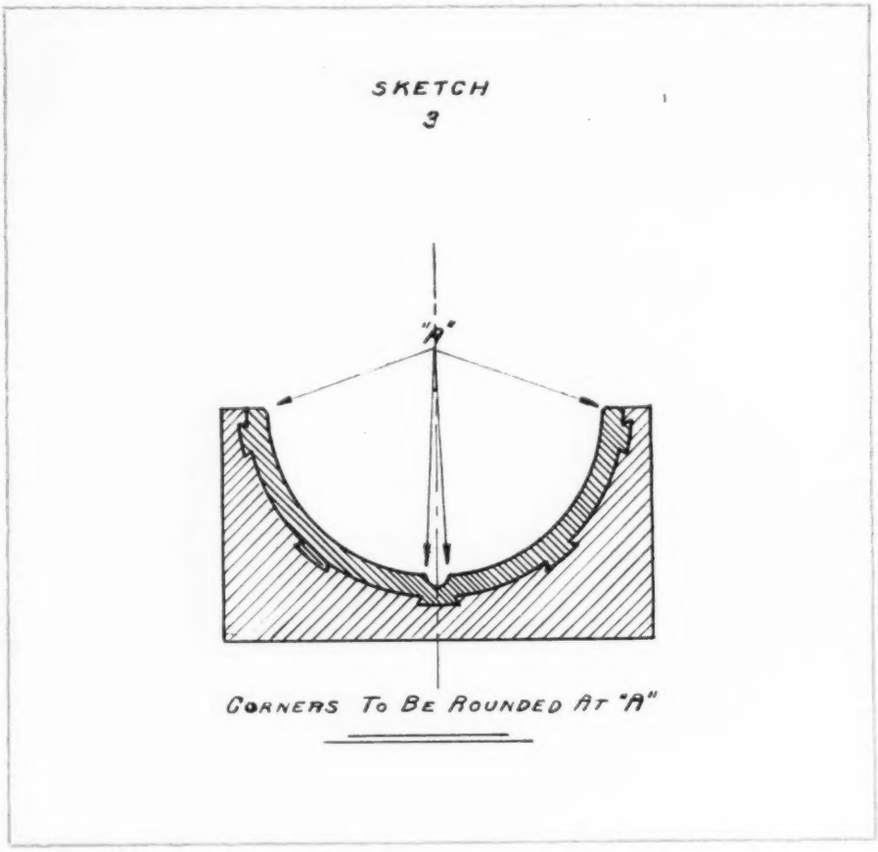
Where v = velocity of rubbing in feet per second.

Where C = constant having values which vary from 800-foot pounds per second in the case of iron or low-carbon steel shafts to 2,600-foot pounds in the case of high-carbon steel crankpins.

This formula is applicable for bearings running at ordinary speeds, but it must be modified for extreme cases.

Although no attempt is being made to study machine design, these formulae are included as no method of lubrication can successfully cure friction troubles where these are due to wrong dimensioning of parts. Oil will only stand a certain amount of pressure before it breaks down and the fluid film is destroyed, consequently, the question of bearing pressures, etc., must be considered. It is never safe to load a bearing to its limit and the following formula gives approximately what a bearing will stand without seizure:

$$p = \frac{PK}{DN + K}$$



Where p = allowable pressure in pounds per square inch of projected area.

D = diameter of bearing in inches.

N = revolutions of journal per minute.

P = the maximum safe pressure under given circumstances at slow speeds. For shaft bearings "P" may be taken as being 400; for crankpins 1,200, and for wristpins 1,600. Although higher values may be taken where workmanship is of the highest and the oiling system in every way first class, in the average case the figures given should not be exceeded.

K = a varying figure depending on the manner in which the bearing is lubricated. These figures may be taken to be as follows:

Where first-class system of drip-feed is used and every attention is paid to the question of lubrication, the figure can be taken to be 1,000.

For average drip-feed oiling, 700.

For force-feed and ring oiling lubrication, the figure represented by "K" can be taken to be from 1,200 to 1,500. At no time, unless the bearing be water-cooled, should the figure of 1,500 be increased for the type of work under consideration.

It should be noted that the formula given is for journals only. When dealing with sliding friction such as that met with in sliding shoes, the value 240V should be substituted for "DN" in the equation "V" representing velocity of rubbing in feet per second.

The correct choice of lubricant, proper attention to the manner in which bearings are adjusted for clearance, the cutting of grooves and the proper dimensioning of journals and bearings, will do much toward reducing friction losses in bearings and will result in more economical operation.

Announcing the

MARATHON OIL COMPANY

A SUBSIDIARY OF THE OHIO OIL COMPANY

... Refiners and Marketers of Marathon Petroleum Products

A change designed to identify the company more closely with its famous products, as it combines in one company under the name Marathon, the Transcontinental Oil Company (of Ark.), Mid-Kansas Oil & Gas Company (Marketing Division), and the Trans-Missouri Oil Company » » » » » »

General Offices, Tulsa, Okla.

When writing MARATHON OIL COMPANY *please mention The Petroleum Engineer*

Some New Developments in Well Surveying Apparatus

By

G. L. KOTHNY*

IT is hardly necessary to discuss from all angles the importance of drilling straight holes. This subject has been dealt with extensively, by a great number of men prominent in the field of oil production, in papers read before learned societies. It has been discussed freely in many articles which appeared during the last two years in various trade papers dealing with oil production.

Crooked holes now constitute a recognized problem, and the year 1928 saw the commencement of widespread effort to drill straighter holes, which has brought about the development of a large number of devices and several types of apparatus that will give the oil man a permanent record of bore holes carried to great depth and taken with speed; that will show him both the vertical inclination and the direction of the inclination. These devices are called well surveying instruments or clinographs. They can be put into two distinct groups.

First: Those which give the inclination from the vertical only. These are used in daily routine work, enabling the driller to correct immediately any deviation of the hole from the vertical.

Second: Those which not only indicate the vertical inclination, but also give the direction in which the well is going and the location of the bottom of the hole, showing the operator how to throw the well back toward vertical, either by careful attention to the drilling method, or by orienting a whipstock or by plugging and redrilling; also producing for the geologist an oriented core for the purpose of obtaining complete information as to underground conditions, and that he may interpret drilling results.

A review of various clinographs is given in Dr. Lahee's paper "Problem of Crooked Holes" (1), also in articles "Crooked and Drifting Holes, Causes, Effects and some suggested Remedies," by H. W. Westsmith and Laurence R. Cook (2) and "Pioneers had Crooked Hole Problems," by H. B. Goodrich (3), and "Crooked Holes," by Paul J. Howard (4).

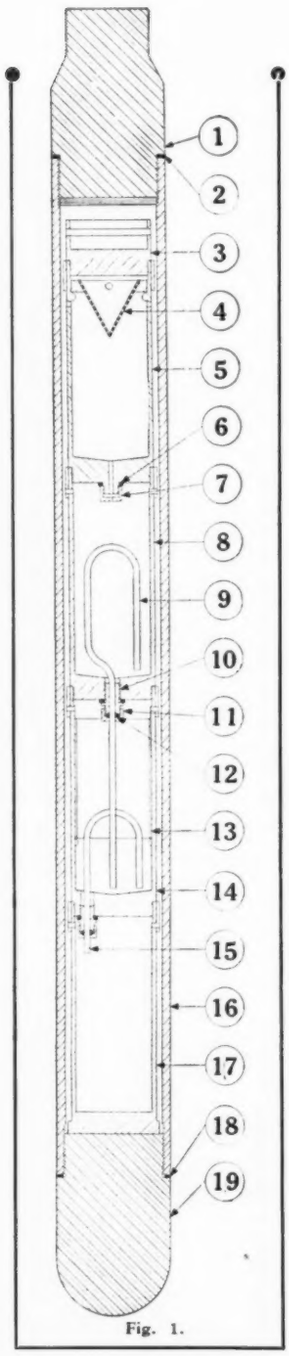


Fig. 1.

Since the appearance of these publications further developments in clinographs have been made and since the interest in such instruments seems to be greater than ever, it seems timely to present data on two of these, which have been recently brought into the field and which fulfill the outstanding desideratum of the oil producer, viz., making oil well surveys accurately and with a minimum loss of time.

The advancement in the straight hole drilling technique has taught the driller that a hole starting to go crooked could be corrected, if the deviation was observed in time. This brought about the inauguration of daily tests and the acid bottle came to the forefront. Its design, use and disadvantages are well known. Many drillers do not care to use this device, due to the inherent defects, which can be briefly summarized as follows:

Danger of injury to persons handling the hydrofluoric acid, the burns of which are exceedingly painful and very slow to heal. Such injuries may result from breakage of the glass bottle, or the melting of the wax containers, particularly in warm climates.

Necessity of obtaining supplies of acid frequently, as it cannot be handled in large quantities. Inaccuracy of readings, due to variations in the thickness of the walls of the glass bottles and due to being fringed with irregular striations. Necessity of using goniometers for making readings, which delays the obtaining of the desired information. High cost of operation and the inconvenience of storing the bottles for record purposes.

These defects have stimulated improvements in the design of this apparatus and various replacements of the acid bottle have been put on the market, among which the Syfo Clinograph (Mr. W. E. Winn's invention) is one of interest, as it represents a radical departure from the methods usually employed.

The principal characteristic of this instrument is the use of an orifice in combination with the siphonic action of a liquid to control the flow of the recording fluid (ink) into and out of the recording chamber, so that the record is made when the instrument is at the desired location.

A cross section through this instrument is shown in Fig. 1.

It consists of an outer or protective casing, (16), closed at both ends, with steel plugs, into which is inserted a brass column, consisting of four chambers, screwed together in the following order from top to bottom: Orifice Chamber (5), Delivery Chamber (8), Recording Chamber (14), and Receiving Chamber (17).

Orifices (7) of different bore can be screwed into the bottom of the orifice chamber. The bore of the orifice

* Sperry-Sun Well Surveying Co.

controls the flow of the recording fluid into the delivery chamber (8), which is provided with a large siphon (9), reaching into the recording chamber (14), which is also provided with a siphon (15) of smaller dimensions, reaching into the receiving chamber (17).

The instrument is operated thusly: One sheet of recording paper is inserted into the recording chamber by means of a paper guide. The proper size orifice, according to the depth of the well is selected and screwed tight into the bottom of the orifice chamber and all four chambers are screwed together in the order before mentioned. The orifice chamber is filled with a definite amount of recording fluid, its top is closed by means of a plug, the column is put into the protective casing in a vertical position and the casing is screwed tight and lowered into the hole. The recording liquid discharges through the orifice (7) into the delivery chamber and fills it slowly until the surface of the liquid reaches the top of the bend of the large siphon (9). The time consumed up to this point of the operation is equivalent to the time necessary for lowering the instrument to the desired depth plus a safety factor of a few minutes.

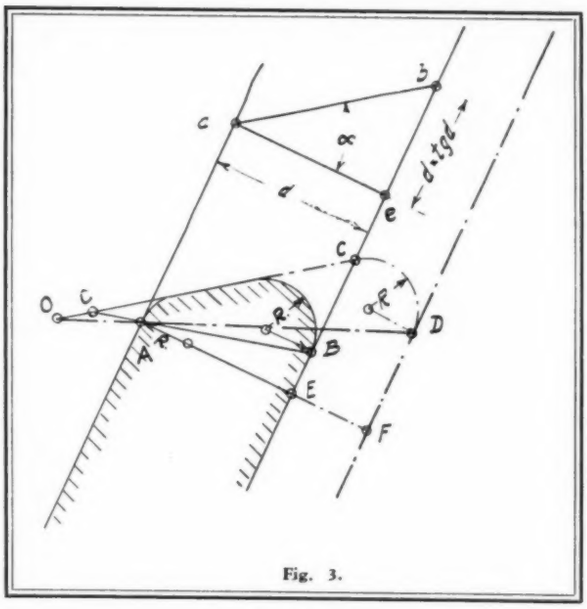


Fig. 3.

Upon reaching the top of the bend the siphonic action of the liquid causes its discharge through the siphon into the recording chamber, where the liquid also gradually rises. Again upon reaching the top of the small siphon this performance is repeated. The discharge from the recording chamber to the delivery chamber is slower than the inflow into the recording chamber, which causes the level of recording fluid to rise gradually, until the large siphon draws air, when the level in the recording chamber quickly drops, drawing all the liquid into the receiving chamber, leaving the recording chamber practically dry, preventing the blotting of the record. The liquid leaves an impression in color, on the recording paper in form of a wavy curve with a high and low point, which corresponds to a similar curve which would be obtained if one could cut the acid bottle open and roll it out in one plane.

Theoretically, the vertical distance between the high and low point of the curve would represent the tangent of the angle of vertical inclination, with the inside diameter as a basis; due to surface tension and capillary attraction (see Fig. 3) there is a slight reduction in the theoretical tangent scale, depending upon the diameter of the cylinder.

A scale taking into account the before mentioned reduction in depth has been accurately prepared and is printed at the top of the recording paper. In addition, the recording paper is provided with horizontal lines spaced one degree apart for readings up to a maximum of ten degrees; the variations in the tangents being so small as to be impossible to be observed by the human eye. For reading angles up to ten degrees it is only necessary to count the number of spaces in a vertical direction between the high and low point. For inclinations of over ten degrees, the scale at the top is used.

Fig. 6.

The advantages of this instrument are that it gives a more accurate record than that obtainable from an acid bottle without the use of any acid or liquid dangerous to be handled, that the record is immediately available as it can be read directly by the driller without the use of another instrument and that it is printed on paper and can be easily kept for record purposes; also, that taking the record requires less time, as the imprint on the recording paper is made instantaneously.

Fig. 4.

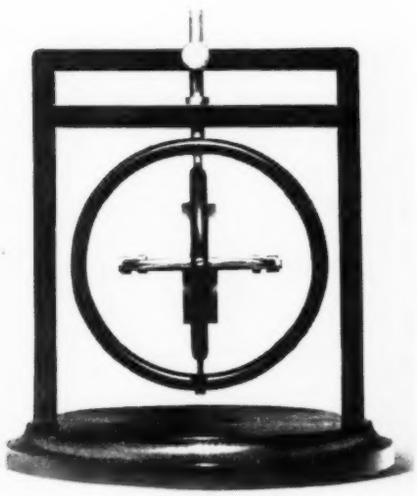


Fig. 5.

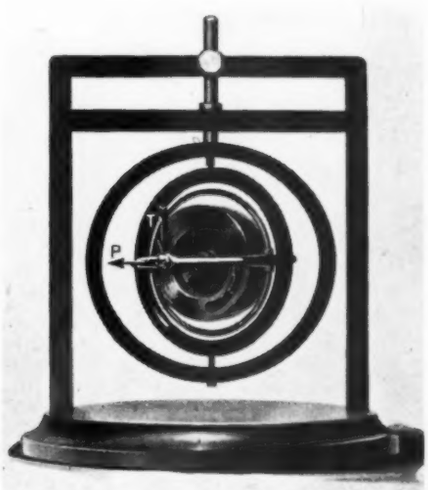


Fig. 7.

Patented Casing Tools and Hook-up

By HINDERLITER

Peculiarly constructed to accommodate high and excessive well pressures

When writing Hinderliter Tool Co. *please mention The Petroleum Engineer*

The instrument can also be dropped into the hole inside of the drill stem, prior to pulling out the latter. A special outer protective casing and a special sub, containing a catcher, are provided for this purpose. This method is gaining in popularity as it causes the least delay in drilling operations.

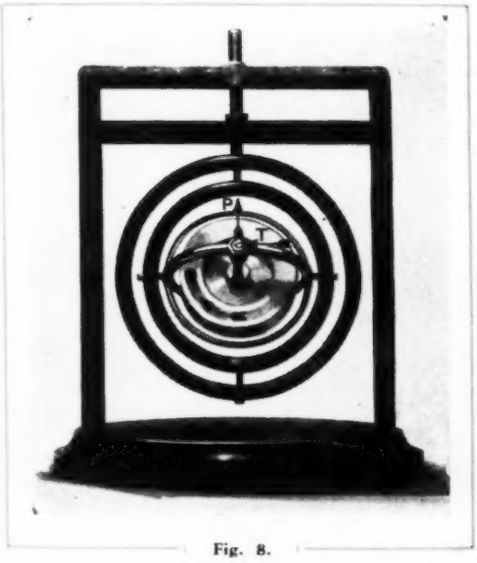


Fig. 8.

Having observed a considerable deviation from the vertical, it often becomes necessary to know the direction of the deviation. During the last few years three methods have been employed for this purpose which can be enumerated as follows: 1st. Drill stem orientation. 2nd. Magnetic compass. 3rd. Gyroscopic compass. The reliability of the first method, which has been extensively used, and the accuracy of which has been made the subject of a paper by R. P. McLaughlin, before the American Association of Petroleum Geologists at their New Orleans meeting, March 21st, 1930, might be made the occasion for discussion. The three errors in Mr. McLaughlin's paper, i. e. instrumental inaccuracy, measurement of orientation and erratic behavior of the pipe are not all which should be considered. There is also "Tortuosity," the quality or state of being tortuous. What is the meaning of tortuous? According to Webster: "Bent in different directions, wreathed, twisted, not in one plane, not straight forward, sometimes deceitful."

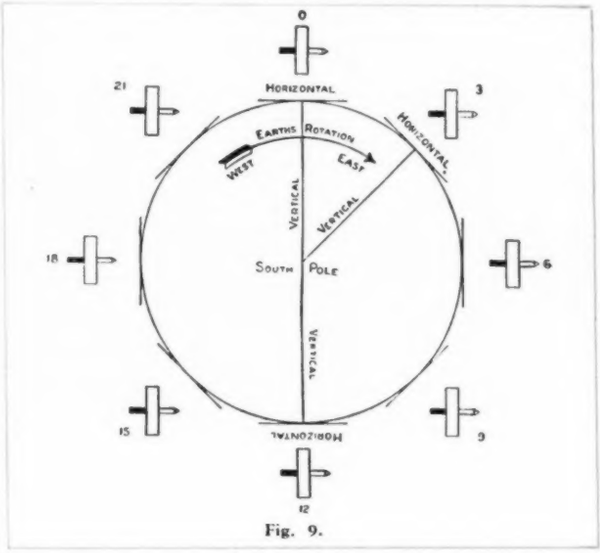


Fig. 9.

Tortuosity of a pipe or drill stem may be explained as the rotation or apparent twisting of a pipe segment in a well relative to the surface segment of the pipe due to the bending of the pipe joining the two segments when the bends lie in other than vertical planes.

To illustrate tortuosity, let us take an extreme case. We will use a speedometer cable to the ends of which are attached two round discs for orientation purposes. The speedometer cable is hung up vertically and a white line or index line is drawn over the two discs and the cable in a North-South plane.

Now if we hold one end of the cable and try to twist the other to the right and to the left, we find this cannot be done. Now we take the cable and bend it first into a horizontal direction in the North-South vertical plane, then we bend it in a horizontal plane ninety degrees East and then again ninety degrees downward in a vertical plane. Then we follow the index line and find that the same has stayed on top of the cable, when making the first two turns and that it follows downward on the east side of the cable below the third turn, while at the upper end or at the surface the index line is still pointing due North.

Considering this cable as a drill stem, the operator at the surface has no way of telling that this 90-degree rotation of the index line has taken place and he will be in error 90 degrees in his conclusions as to the direction of any inclination from the vertical.

This is an exaggerated case but serves to show that there is a considerable error in the rotation of a lower pipe segment due to bends in a horizontal plane.

Let us now consider another example. A straight vertical hole up to a depth of about 1000 feet bends gradually in a North-South plane and increases its vertical deviation to about 15 degrees and then follows a nearly true helical path in a clock-wise manner, (as if the pipe were wrapped around a cylinder of several hundred feet in diameter). The index line will always lie directly on top of the pipe, i. e. directly in a vertical plane passing through the longitudinal axis of the pipe. This means that while the index line at the surface is maintained in a North-South direction, as we pass down the helical pipe the amount of inclination, 15 degrees being maintained constant, will always be rerecorded by the recording device as being in the direction of the index line and this direction will be successively North, Northeast, East, Southeast, South, etc., as we continue down the helical path, but the operator at the surface will think that the index line in this path is pointing North, since the index line at the surface is pointing North. Consequently, it will not be possible

Fig. 10.

When writing SPANG, CHALFANT & CO., INC., *please mention The Petroleum Engineer*

Fig. 11.

from such a survey to deduce the true course of the borehole.

A theoretical analysis of the effect of tortuosity in its bearing on the surveying of crooked holes by orientation from the surface has been prepared by J. M. Pearson. This analysis shows that the tortuosity must also be directly measured in order to correct the azimuth at the bottom and, since that cannot be done, there is no way of correcting the azimuth for the tortuosity errors and ascertaining the true course of the above hole.

Orientation by magnetic compass is also subject to unknown errors. First the angular difference between true North and magnetic North has different values at different locations on the earth surface. While these values are known over greater intervals of distances, it would be impractical to determine these values for spaces in which oil wells are being drilled. It is however admitted that the variation of these values is very small and hence the errors caused by it are unimportant.

Second, another more serious error is that produced by the magnetism of the lower end of the drill stem, which always becomes strongly magnetised due to jars and hammering and which has two sources, the permanent magnetism hammered into the drill stem and the deviation caused by the magnetism induced into the drill stem by the earth magnetic field. This error is indeterminable, as there are too many unknown influences, even temperature changes bearing on these values.

Third, isolated masses of magnetic rock encountered in the bore hole may also cause an error in disturbing the horizontal component of the earth's field. Experiments with magnetic orientation have not been uniformly satisfactory and comparative tests made between the gyroscopic and magnetic compass orientation have led to the definite conclusion that magnetic compass orientation is unreliable in cased holes and somewhat erratic in open holes.

The gyroscopic compass' usefulness in marine and air navigation is well known and its widespread adoption on several thousand ships, replacing the magnetic compass, speaks for its reliability and usefulness. Its existence is based on the deficiencies of the magnetic compass. Its usefulness has now, after several years of research and experimenting, been extended to oil production activities. A brief and non-technical explanation of its phenomena will be given.

A gyroscope is a rotating wheel supported in such a manner as to be free to move about all axes. Such a wheel is shown in Fig. 4. It can move about: 1st. Its spinning axis. 2nd. Its vertical axis. 3rd. Its horizontal axis. It has three degrees of freedom. If we take such a rapidly spinning wheel (Fig. 5) and tip the supporting base as shown in Fig. 6 the original plane of rotation will be maintained regardless of the movement of the supporting base provided no appreciable troupe is applied to the gyroscope by reason of friction about either the horizontal or vertical axis of support. This phenomenon or first property of the gyroscope is called rigidity, i. e. its tendency to maintain its plane of rotation fixed in space.

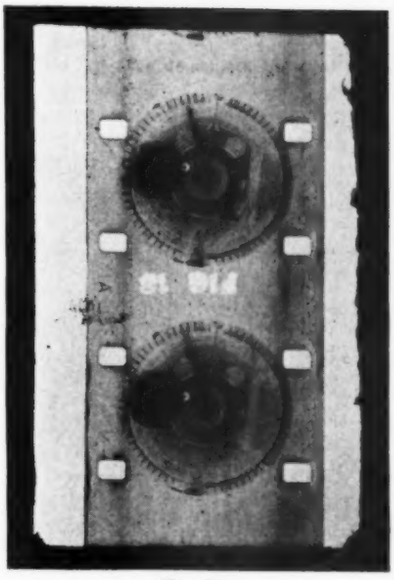


Fig. 12.

The second property of the gyroscope is precession, i. e., its tendency, when subjected to torque (rotational force) to turn about an axis at right angles to the axis of the torque. The phenomenon of precession may be illustrated by applying a torque to the spinning wheel, which meets with great resistance. And instead of motion taking place in the direction of the applied torque T (see Fig. 7), the wheel turns around its vertical axis in the direction indicated by the arrow P. Correspondingly, if we apply the torque around the vertical axis, the wheel will move around a horizontal axis as indicated by P in Fig. 8. The direction of precession is always 90 degrees away in the direction of the wheel's rotation.

Due to the rigidity in space and the earth's rotation, the Gyro will appear to move at the rate of one revolution in twenty-four hours, as will be seen in Fig. 9. If mounted on the surface of the earth at the equator it will appear to move about the earth's horizontal; if placed at the north or south poles it would not move about the horizontal but would appear to move about the vertical; and at any point between the poles and the equator it would appear to move partly about the horizontal and partly about the vertical.

The Gyro can be made to act as a compass which will indicate the true North-South meridian, by properly supporting it and controlling its reactions to the rotational motion of the earth.

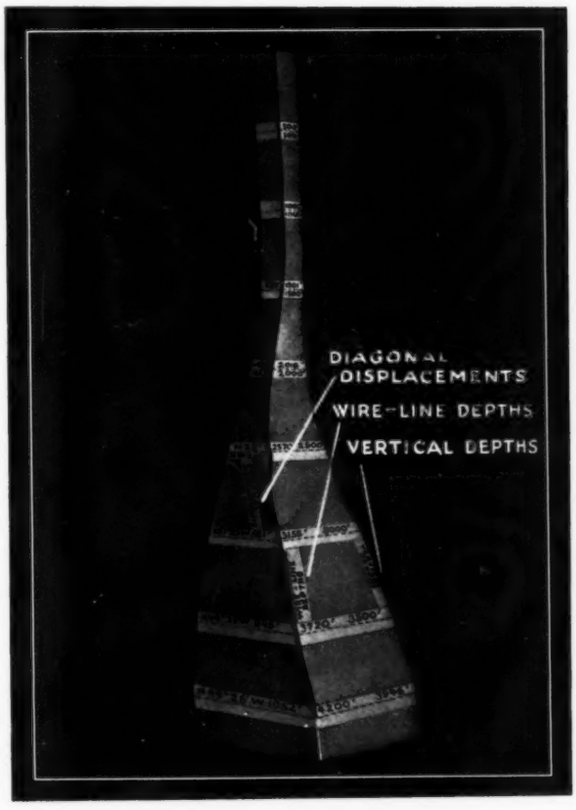


Fig. 14.

A compass of this type is called a "Meridian seeking Compass" because it has the power to return itself to the Meridian if moved away by some disturbing force. To possess this force a Gyro must have a relatively large moment of inertia which requires size and speed, together with appendages to control its precessional motion.

The limitations in the size of bore make it hardly possible to use this type of Gyro compass as its dimensions would not permit it passing through the holes. In order to be of practical use, the outside diameter of a bore hole surveying apparatus should not exceed 5½ inches. Allowing one-half inch thickness for the walls of the protective casing the space available for the Gyro is limited to a circle of 4½ inches diameter.

The Sperry Gyroscope Company after several years of research work and experimenting has however developed a new small gyroscopic directional indicator, the operation of which is based upon the gyro's rigidity in space. This type of gyroscopic directional indicator if placed in a position will not return to it. Such a gyroscopic compass will operate very accurately during short tmie intervals and as are required for bore hole surveys.

This type of Gyro compass is used in connection with the Surwel Clinograph as shown in Fig. 10 and 11.

The Surwel Clinograph consists of three units assembled in the order named. The unit at the lower end is the Gyroscopic Unit. It consists of a specially designed small motor driven gyroscope, operating at from ten to fourteen thousand revolutions per minute. This gyroscope is balanced in such a manner that it will maintain its axis in a north-south plane for a long time if once placed in this direction. The axis of the gyroscope controls a pointer, pointing in the same direction as the axis, which is arranged on top within a compass scale. To the latter is also attached a non-magnetic watch having three hands, the hand indicating seconds being of the same size as that indicating the minutes, making it possible to read as close as a fifth of a second in the picture taken.

Above this unit is located the Camera Unit. This consists of a camera of rather original design. It is operated by a small electric motor which unwinds the 16-mm. perforated motion picture film. The film take-up tension is provided for by a spring belt driving the take-up spool sleeve, which takes fifty-foot rolls. The camera has two lenses, which are very accurately set for alignment as well as focus, and which record pictures simultaneously in two opposite directions. One photographs the gyroscopic pointer, the compass scale and the watch located below, and the other the location of the bubble in the box level gauge located above the camera unit. The necessary light for the making of these pictures is obtained by means of a lamp contact controlled by the motor through gears and a cam and lever action, against a double spring contact. This contact is adjustable. Arrangements are also provided to control the motion of the camera motor from a timing device arranged on top of the instrument.

Above the Camera Unit is located the Inclination Unit. This consists of a spherical box level gauge with concentric graduations. The bottom as well as the top of the gauge are both made of transparent glass. The nature of the fluid

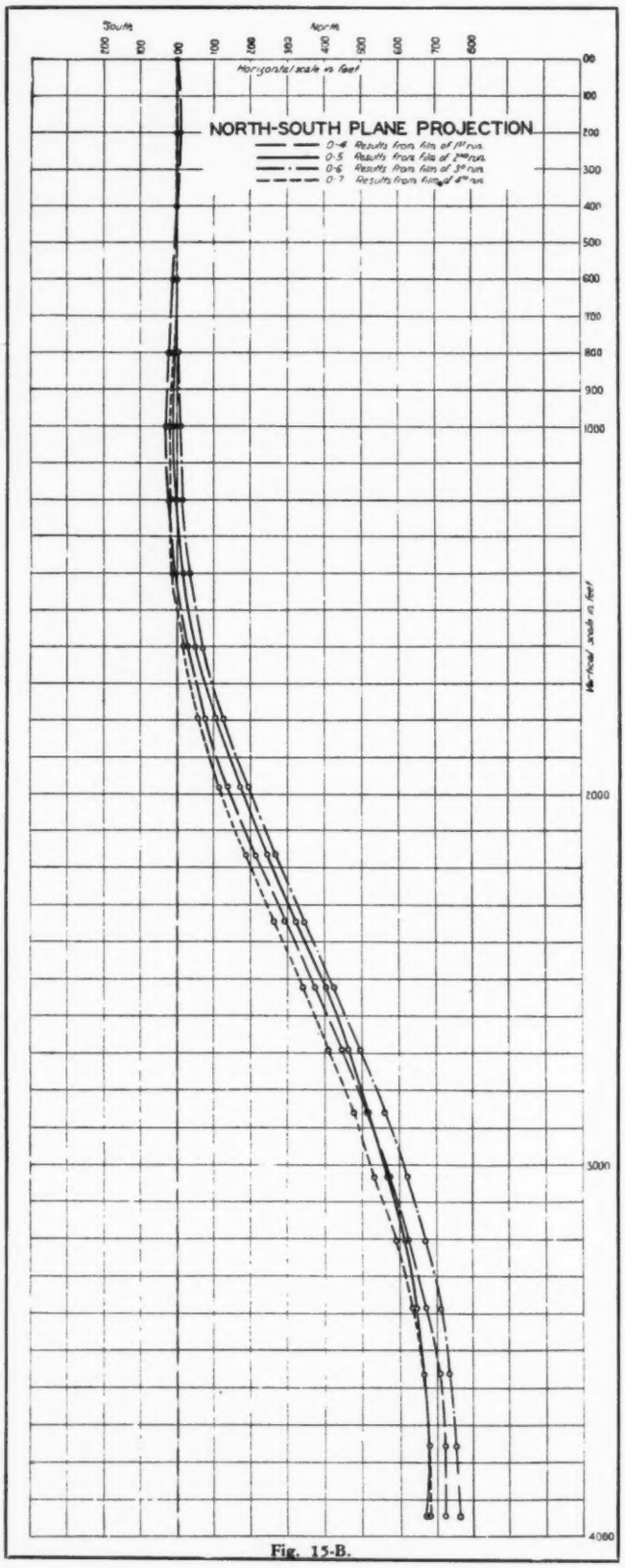

South
North
Horizontal scale in feet
NORTH-SOUTH PLANE PROJECTION
0-4 Results from film of 1st run.
0-5 Results from film of 2nd run.
0-6 Results from film of 3rd run.
0-7 Results from film of 4th run.
Horizontal scale in feet
4060

Fig. 15-B.

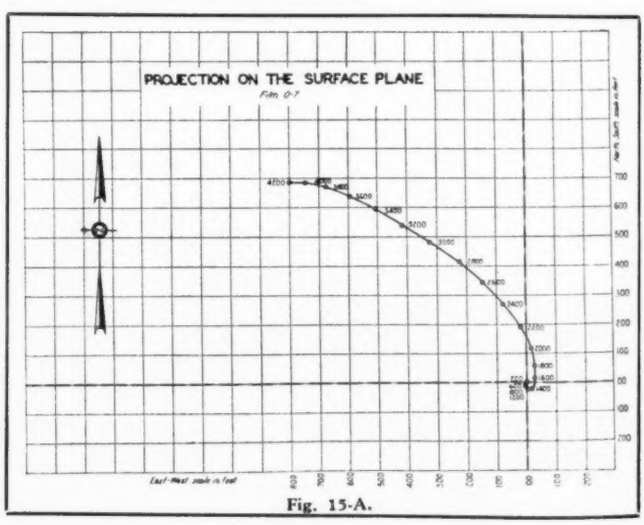
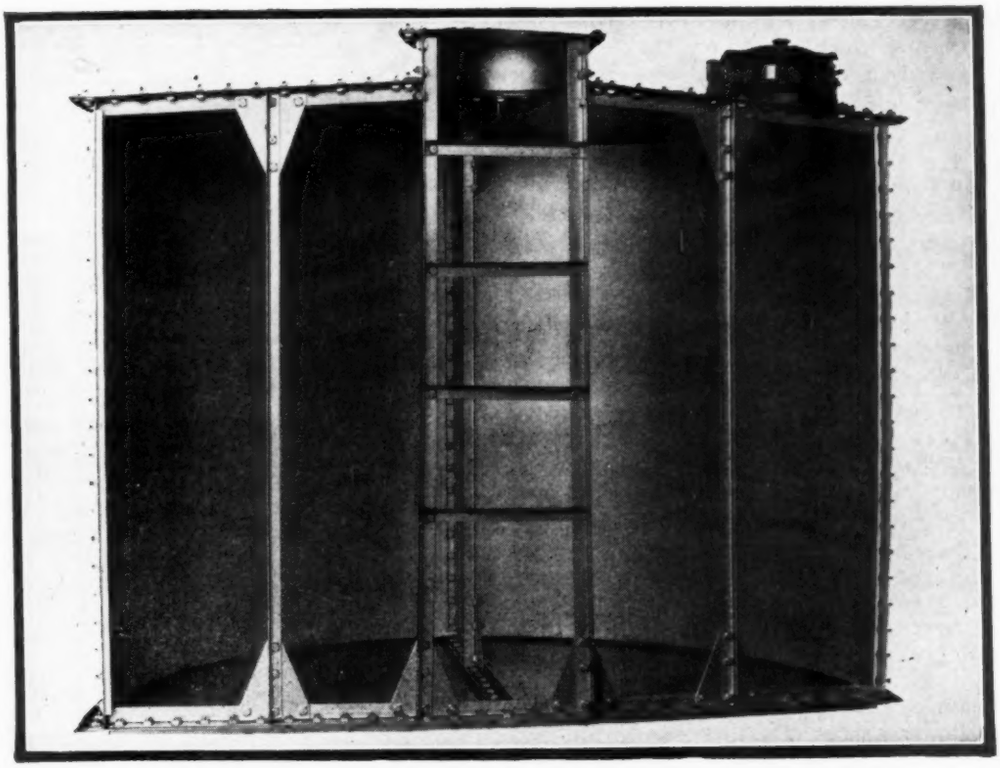


Fig. 15-A.

DURING the EXPOSITION



MADE BY KEYSTONE AMERICAN

See us at Booth 14, Refiners and Marketers Building, and examine the model showing the design and construction of MALONEY *Vapor-Pressure* Tanks.

Study the Automatic Pipe Line Pumping Station on the Exposition Grounds . . . note the MALONEY tanks.

Visit our Plant at 108 North Peoria Avenue, Tulsa, where MALONEY Bolted Steel Tanks are manufactured.

» » »

MALONEY TANK MFG. CO.

Tulsa, Oklahoma, U. S. A.

Distributors at All Principal Petroleum Points

MALONEY PATENTED BOLTED COPPER-STEEL TANKS

and the size of the bubble are such as to dampen oscillations of the bubble, but at the same time prevent lagging of the bubble. Each inclination unit consists of three level gauges, one for a maximum inclination of 20 degrees, one for 40 degrees and one for 55 degrees. Since the maximum inclination of a well is generally known from simple test previously made for verticality, the proper box level gauge can be selected and the greatest possible accuracy can be obtained.

The box level gauges are provided with expansion coils so as to obtain the proper performance of the bubble under varying temperatures.

The three units are assembled inside a high-pressure steel case made up in three joints. The two lower joints carry the power plant. They are filled with dry cells arranged in crates. A spring shock absorber is provided at the bottom of the lowest joint and a swivel or a special sub is used depending whether the instrument is lowered into the hole on the drill stem or on a wire line.

The operation of the instrument is briefly as follows:

The two lower joints of the protective steel casing are inserted into the well resting on slips. The gyro which is operating is mounted and oriented toward the north, the camera and inclination units are placed on top of gyroscopic unit and the third joint is stabbed over the instrument and closed tight.

The instrument is now ready for use on either the wire line or the drill stem. If lowered on the wire line, time readings are taken by a watch synchronized with the watch of the Gyroscopic unit every 25 feet to the depth of the survey; thus fixing the depth at which each photograph is taken. The instrument runs at a rate of about 3 feet per second.

If lowered on a drill stem the protective casing is attached to the drill stem by a special sub provided with holes for mud circulation. Also a timing device is attached to the top of the instrument, which controls the operation of the camera motor to take pictures at every fourble in and out and while these are standing still. The length of the time interval depends upon the speed at which the crew are able to make fourble connections, which also in turn depends upon the equipment available on the derrick but it should not exceed 2½ minutes per fourble for wells 8000 feet deep.

After the instrument comes to the surface it is disassembled and the film is removed and developed. It shows pictures as illustrated in Fig. 12.

The film shows the vertical inclination as well as the orientation. Corrections for the cardinal error, parallax and refraction, all of which have been truly established by the manufacturer through exhaustive tests, are applied to these pictures and a map of the well can now be easily prepared. This map consists of three projections, one vertical in a north-south plane, one vertical in an east-west plane and one horizontal. From this map the true position of the well at any horizon or point in the well fixed by wire line measurement or other linear measurement taken down the course, or its relative position to the mouth of the well can be ascertained.

Fig. 14 shows a model of a bore hole constructed from the three projections mentioned above and Fig. 15 shows the three projections of four independent runs of the same hole. It may be noted that the errors arising from instrumental inaccuracy and interpretations of the photographic results are very small and have never exceeded one-half per cent of the depth of the hole.

The greatest advantage of this instrument is the small amount of time required for making a survey. Further, that the results of the survey are confidential and are known only to one person, which person does not need to be the man who actually made the survey. The owner of the well can, if desired, obtain the undeveloped film and develop it and make the computations himself.

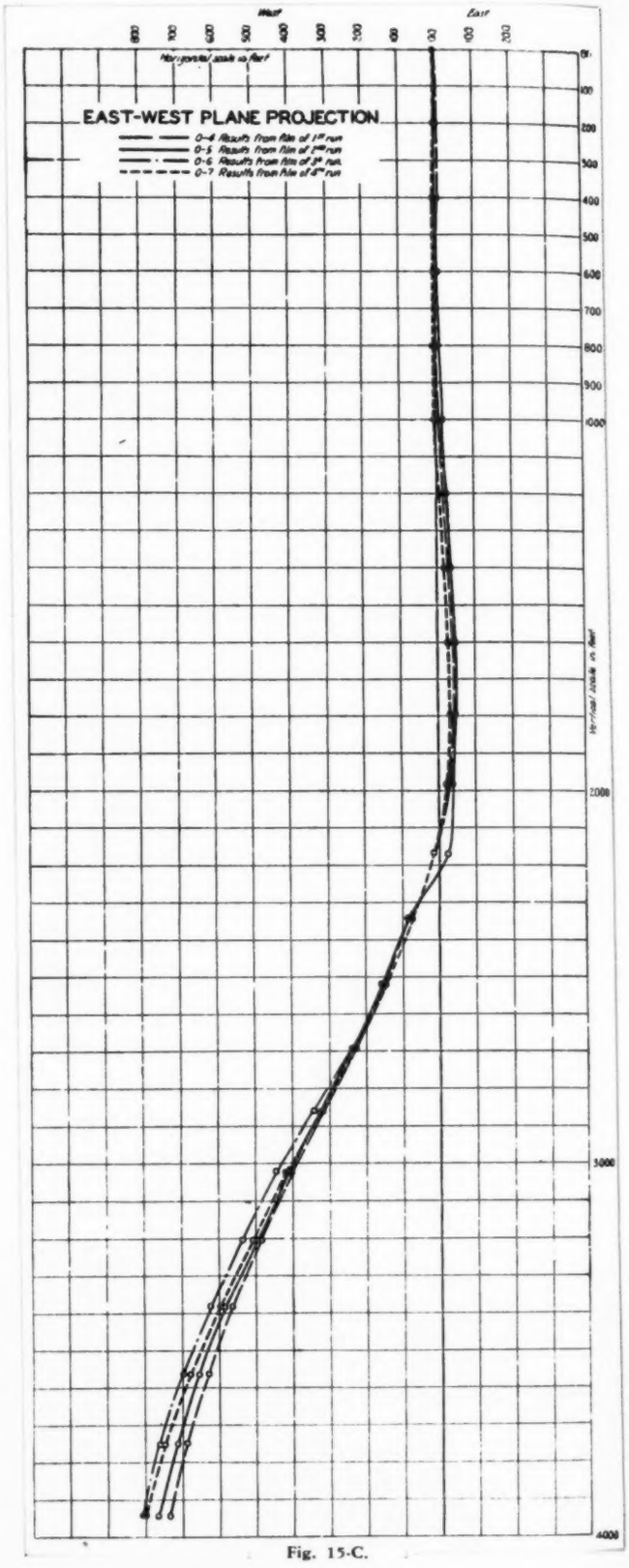


Fig. 15-C.

In conclusion it may be said that surveying of bore holes should not be considered a passing fad. On the contrary it has become a new branch in oil production activities which is of utmost importance and of unquestionable value to the producer.

Shackle Rod Problems in California Fields

By W. A. SAWDON,
Petroleum Engineer, Los Angeles, Calif.

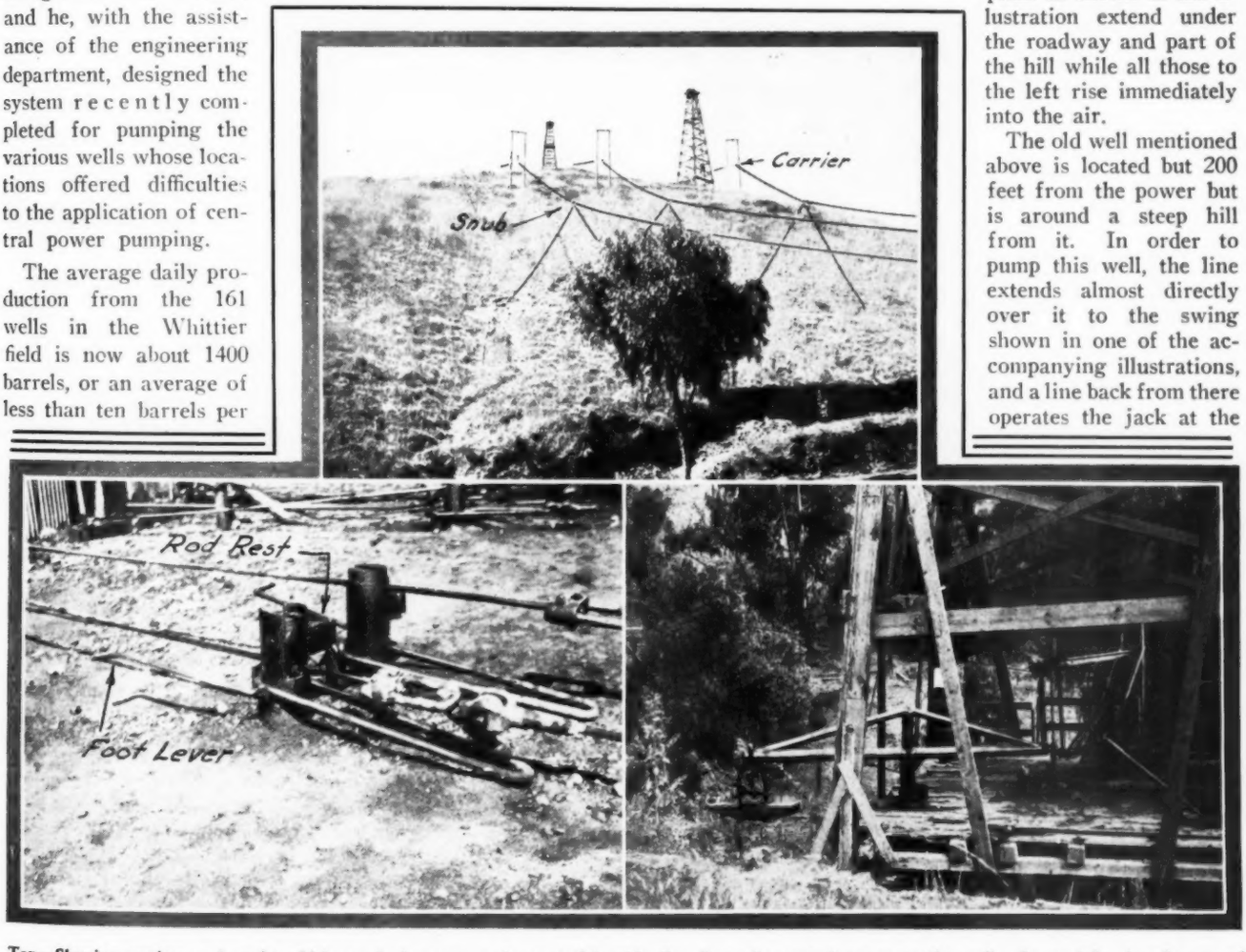
THE topography of the land on which oil wells are located often offers a serious problem to the installation of central pumping powers when other conditions in the field have made it most advisable to use that method of production. No difficulties are encountered when the terrain is comparatively level or merely broken with rolling hills. But when the wells on one lease, or adjacent leases to be pumped from one power, are located on steep slopes, in deep ravines or valleys or around a hill from the central plant, a considerable amount of engineering must be used to solve the problem.

In the old Whittier Field, located southeast of Los Angeles, California, such conditions are found. Many of the wells have been pumped with jacks operated by central powers for a long time but a number on the Central Fee of the Standard Oil Company of California offered a problem in laying out a system which would not require an excessive amount of power nor build up too much friction in the lines. The company's production in the field is in charge of E. W. Crooks and he, with the assistance of the engineering department, designed the system recently completed for pumping the various wells whose locations offered difficulties to the application of central power pumping.

The average daily production from the 161 wells in the Whittier field is now about 1400 barrels, or an average of less than ten barrels per well per day. There are twenty-one wells being pumped from the system here described with one of these wells nearly forty years old and making but one barrel of oil per day. The depth of these wells range from 900 feet to 3000 feet. Casinghead gas is pulled from them under a vacuum of about 12 inches mercury and is passed through a natural gasoline plant located on the fee.

The central power is located in a ravine as shown in one of the accompanying photographs. The road that can be seen to the right of it originally passed over a bridge at that point, but sufficient excavation was necessary around the building to provide a fill over which the present road could be built. The power consists of the large 24-foot band wheel driven by a 40-horsepower single-cylinder gas engine which was moved in from another field. Fuel is residue gas from the gasoline plant. Rods are used only from the band wheel to the first connections and 1-inch wire rope necessarily supplies all transmission of power from that point to the wells. All pull lines from the right of the plant as shown in the illustration extend under the roadway and part of the hill while all those to the left rise immediately into the air.

The old well mentioned above is located but 200 feet from the power but is around a steep hill from it. In order to pump this well, the line extends almost directly over it to the swing shown in one of the accompanying illustrations, and a line back from there operates the jack at the



Top—Showing carriers and snubs which are both necessary in an aerial cable line from the central power to the well. Lower left—A safe way of connecting and disconnecting lines. Lower right—Type of counterbalance used in this work.

well. This swing is built on a ledge on the hillside opposite to that shown in one of the accompanying pictures and across another ravine branching from the one in which the plant is situated. Seven other wells are also pumped from this swing, five being at a higher elevation and two at a lower. Direction is here changed in a horizontal plane only since the wells being operated from it are far enough away to allow the difference in elevation to be taken care of by carriers and snubs.

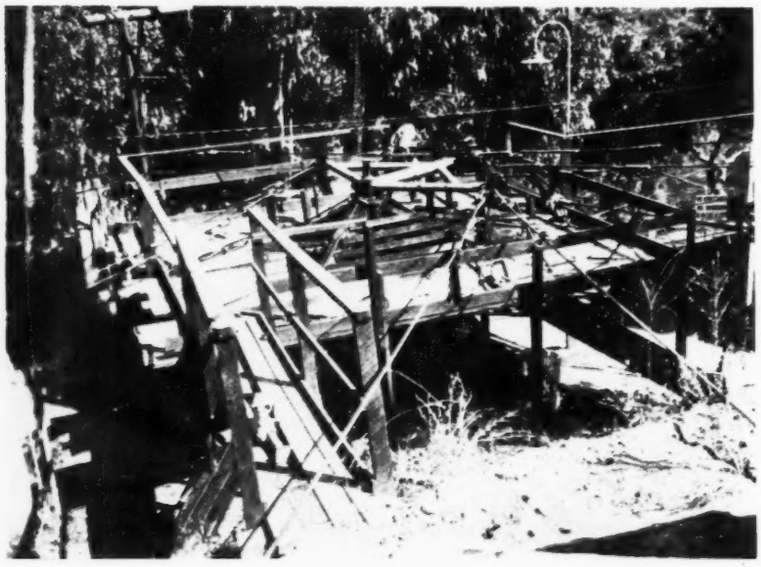


Fig. 1. The Central power located in a valley pumps twenty-one wells at various elevations.

In order to pump the well shown nearest the power in Figure 1, direction had to be changed both horizontally and vertically at the same time. This was accomplished by use of the swing shown in a preceding picture, which provided the least possible loss of power due to friction.

Snubs, as well as carriers, are necessary for aerial pull lines. These are well illustrated in one of the accompanying illustrations, although the three lines here shown passing over a valley probably represent the most easily designed lines of the entire system. To many of the other wells the snubs sometimes have to perform a horizontal function as well as keeping the lines taut vertically; while the carriers are often the only devices necessary in passing over a hill.

A type of counterbalance as shown in one of the accompanying illustrations is used wherever possible. It assists in lifting the rods and the weight is adjustable. It can be placed at any angle or at any place on the derrick floor that may be convenient since it has a fulcrum independent of the jack and does not have to be in line with the jack or the pull line. It cannot, of course, be used on all the wells, especially the ones of great distance from the power; but it has been found most efficient wherever it is adaptable and in a few cases has been used without any weight applied at the end.

An interesting safety feature has been designed for use in putting wells on and taking them off the power. Most devices in general use require the use of the hand in connecting the line from the well to the rod from the band wheel. As here shown, a foot lever has been welded to the link used for holding the line when it is off the power. In disconnecting a line, the operator stands behind the guide, raises the link with his foot and lifts the rod through the slotted guide to the rod rest. His hands are on the band wheel side of the guide at all times and he runs no risk of injuring his fingers as he may when operating the link with his hand. The same holds true when putting a line back on the power.

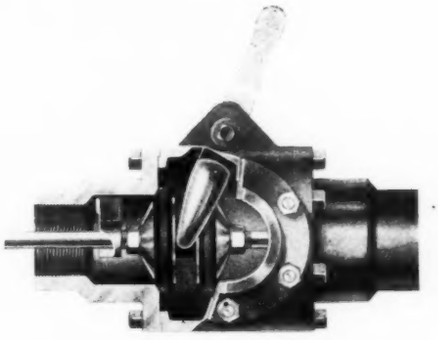
Fig. 4. Several lines run from this point, which is located on a ledge on a steep hillside.

Provision for a stretch in the lines from the power to the well is provided by a turnbuckle placed at the jack. Although climatic changes are very small in this field, it has been found that the line has to be taken up after three or four days of hot weather and let out during a rainy or a cool period. Old casing line is used and little adjustment is necessary for any stretch which might be caused by continuous service in the line.

The entire system has been designed to reduce friction as much as possible and to keep the power requirement to the minimum. Instrument work was used by the engineering department for obtaining elevations and the data secured were used to advantage in planning the work and in making the installation economical in both construction and operation.

Still other successes by Brauer

Stand Pipe Valve



Manufactured under Gill patent appl.

This valve is made to take the place of the commonly used gate valves in your stand pipes.

Its rugged construction insures economy as it has proven that it will last several times as long as the regular gate valves.

You will have no time lost in changing and repairing valves.

It is operated by a hand lever and takes but a second or two to switch from one stand pipe to the other.

It is automatically drained, thereby eliminating any danger of freezing.

Compounding Type Manifold Valve

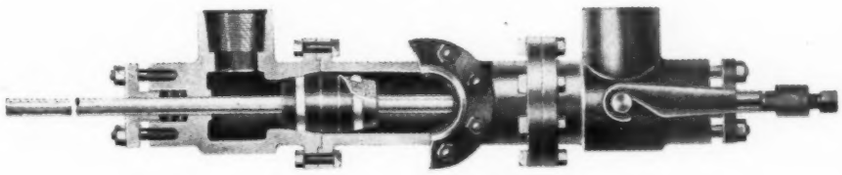
The compounding type manifold valve is made especially for fields where it is necessary to compound your pumps.

The plunger can be locked on either side by means of a set screw yoke which will permit the use of both pumps at the same time.

This valve is used in the manifold between your slush pumps and is for the purpose of automatically closing the discharge line of the pump not in use and diverting the flow of fluid up to the stand pipe.

By closing the steam valve on the pump that you have been using and opening the steam valve on the other, the fluid pressure automatically forces the double tapered plunger valve into the opposite seat and diverts the flow up through the stand pipe. These can be connected up in several different ways and we will be glad to furnish sketches showing them.

Positive in its operation.
Will not sand up under any condition.
Withstands any operating pressure.
Made of high grade cast steel.
Tongue and groove flanges.
Extra plunger valve shipped with each valve.
Packing dovetailed in place.



Manufactured under Beebe patent

OTHER BRAUER PRODUCTS

Swivel Circulating Head
Hydraulic Wall Hook
Shale Separator
Stand Pipe Goosenecks
Compound Brake Lever
Valve Seat Pullers
Elastic Safety Lock Nuts
Special High Pressure Fittings

Sold Through Your Supply Store

Brauer Machine & Supply Co.

Oklahoma City, Oklahoma

Aerial Surveys Aid Pipe Line Location

By HARRY NELSON,
Engineer, Empire Companies, Bartlesville, Okla.

THE pipe line engineer has been more or less reluctant to use aerial surveys for the location of pipe line routings, perhaps due chiefly to two reasons, namely the apparent high cost and the fact that he will not admit that he does not do a good job without them. Having used an aerial survey once, the engineer readily admits that a good location is next to impossible without the use of the aerial camera, and he would as readily go back to the use of a horse and buggy as to locate a pipe line by the old methods.

Most engineers admit that an aerial survey has its advantages but at the same time few are really convinced that it is a wise investment. It would be a very convenient and nice thing to have but they look upon it as an expensive toy, too high priced to be of economical use.

The writer is not attempting to convey the idea that an aerial survey is not expensive. Compared to a ground survey, it is expensive but when one makes an investment that yields an immediate return of several hundred per cent, the investment is a wise one regardless of the original cost. It is difficult to prove that an aerial survey will save several dollars by spending one. The engineer must have definite proof—he must be shown exactly how much he can save before he is willing to invest in an aerial survey, all of which is impossible. After he has used the aerial survey, he has proved to his own satisfaction that considerable saving is effected but he cannot set such savings up as so many dollars, neither can he easily convince others that the investment is entirely justified. Unless one has actually used an aerial survey, he cannot begin to visualize the advantages to be obtained nor the uses to which it can be placed.

A pipe line survey has but two objectives, the shortest and most economical route. The shortest distance between two points has been defined as a straight line but an enormous flexibility of the imagination is required to visualize most ground surveys as approaching that definition. The angles are numerous and large, or the party chief will often stake over objectional topography rather than lengthen the line by large angles. The aerial survey makes it possible to avoid objectionable topographical features by angles so small as to be of little or no consequence. The range of the engineer's eye is transformed by means of the aerial map, from a few thousand feet to the entire length of the line. Instead of hoping he will encounter "good going," he knows exactly what is ahead and can adjust his course accordingly.

The usual procedure of an aerial survey is to lay out on the best maps obtainable the proposed air line between known objective points. The engineer then accompanies the photographic crew on a reconnaissance flight over the line. The reconnaissance flight acquaints the photographic crew with the routing, aids the engineer in choosing objective points and satisfies him that he is photographing the best routing. Since the photographed strip is three miles wide, the reconnaissance flight need be only a means of choosing which three-mile strip shall be photographed; therefore, detail is not necessary. The actual location of the line in the three-mile strip is left entirely until the finished map is assembled.

Clear visibility on a reconnaissance flight.

The center line of the three-mile strip is marked on the ground for the guidance of the photographic crew. Markers may be designated landmarks such as buildings, towns, road intersections, bridges, or may be artificial markers of lime or cloth placed on the ground at strategic points. Artificial markers are usually made in the shape of a cross with panels one hundred feet long and six feet wide. Such a marker shows up boldly on the photograph and, if placed

Circle indicates angle point in two existing pipe lines. This point was used by photographic crew as a marker.

at intervals of ten or fifteen miles, serves as a good alignment check in assembling the mosaic map as well as furnishing a known point from which sections, townships, and ranges can be identified.

Space does not permit a detailed discussion of the photography and laboratory procedure. Since the aerial survey is usually a contract job, a brief outline will suffice. The photographs are taken at an altitude of 12,000 feet and at intervals such that each exposure will overlap the preceding one sixty per cent; therefore, any point will appear on two different pictures. The side overlap between adjacent strips of photographs is twenty-five or thirty per cent. In the assembly of the map, only the central portion of each photograph is used as the outer edges are somewhat distorted or off scale. The pictures are matched together into a continuous mosaic map and mounted on cloth or panel board in any desired length, twenty-five-foot sections being a convenient length for pipe line work. At a scale of 1000 feet to the inch, a twenty-five-foot map represents approximately 48 miles of pipe line. If mounted on cloth, the map can be rolled up for filing.

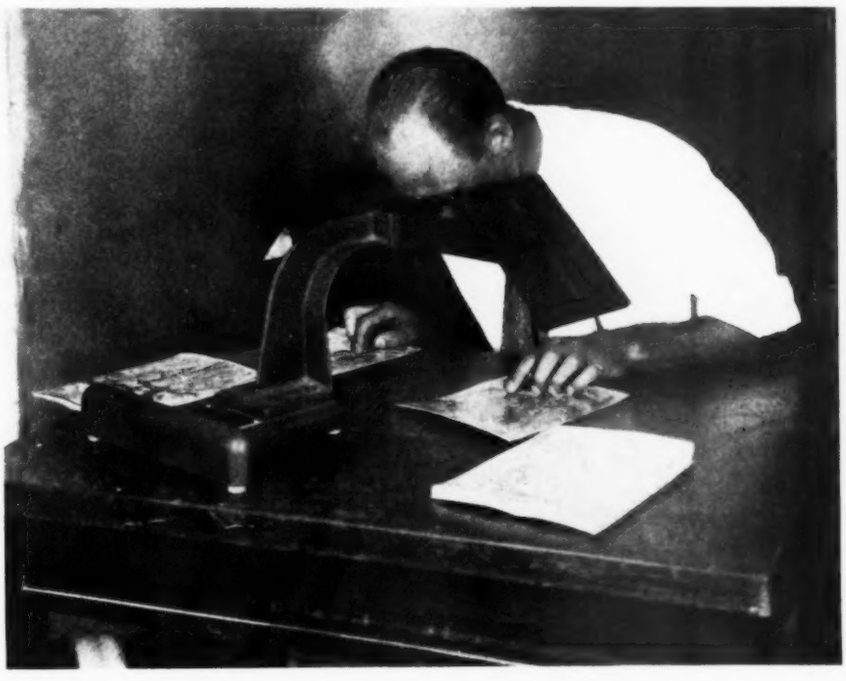
The old-fashioned parlor stereoscope makes possible the third dimension from aerial photography. The stereoscope used by the engineer hardly resembles in appearance the one Grandmother had in the "settin room" but the principle is primarily the same. Two adjacent and overlapping photographs are placed under the "stereo" and adjusted so that an identical point on each exactly coincides. By means of a system of mirrors, the interval between the observer's eyes is transformed from a few inches to several thousand feet. He sees a given object from two different angles and the perception of relief results. Buildings and hills seem to stand out above the surface of the photograph in an uncanny manner. It is not an optical illusion but a scientific means of interpreting the aerial photograph, and without which the aerial map would be worthless to the engineer.

By comparison with the known horizontal scale, vertical distances can be estimated closely enough for practical purposes.

With a relief map, showing absolutely all detail—for the camera forgets nothing—the experienced pipe line engineer can lay out quickly the best and shortest route. A string is stretched from one end of the map to the other, or between objective points, and by shifting the string to avoid buildings and objectionable topographical features, the best route is easily determined. The final location is inked on and such information as section numbers, township numbers, survey blocks, stream names, highways, school houses, cemeteries, etc., are added.

After a little practice, the engineer readily becomes adept at interpreting detail. The overflow area of streams is easily determined by a slight soil discoloration, cultivated fields are identified by the turn rows of the plow, fence lines stand out prominently because of the unplowed adjacent strip, well traveled roads are lighter in color than the unfrequented trails; and even rock outcrops are distinguished by light colored outlines resembling contours, all of which merely proves that with a little correlation a wealth of detail can be obtained from the aerial map.

Until recently, the aerial map had not been adaptable for use in the field. The individual photographs could be taken to the field or tracings made of the original mosaic and blue prints made for field use. The former method is costly if several duplicate sets are necessary, and the line cannot be plotted exactly the same on any two sets of contact prints. The latter method suffered the loss of all the photographic detail. The writer and associates conceived the idea of reproducing the original mosaic map in 22-inch sections by photostating. Two sets of photostatic negatives were made, one called the "engineering" set, and the other the "right-of-way" set. To the right-of-way negative was added such information as property owners, roddages, property lines, and section or survey lines. Nothing was added to engineer-



The stereoscope makes possible the third dimension.

ing negatives. Positives from the engineering negatives were bound up in booklets, together with index county maps showing the geographical location of each photostat by a simple system of index numbers. The staking parties, contractors, construction men, and executives on inspection trips used the engineering positives. The right-of-way positives were similarly bound and indexed for the use of the buyers of rights-of-way. Roddages are computed from scaled distances after being corrected to true scale by a table of conversion factors shown in Table A. Except along the north and west tiers of sections, each mile is assumed to be 5280 feet long, upon which basis Table A is computed. If any mile does not scale exactly 5280 feet, the table gives a multiplier for converting any scale reading to true distance, also a multiplier for converting any scale reading in feet direct to rods.

TRUE SCALE CONVERSION FACTORS FOR AERIAL MAPS

Scale of Mile	Factor for true scale in feet	Factor for rods	Scale of Mile	Factor for true scale in feet	Factor for rods
5000	1.0560	.064000	5500	.9600	.058182
10	1.0539	.063873	10	.9583	.058079
20	1.0518	.063745	20	.9565	.057970
30	1.0497	.063618	30	.9548	.057867
40	1.0476	.063491	40	.9531	.057764
50	1.0456	.063364	50	.9514	.057661
60	1.0435	.063242	60	.9496	.057552
70	1.0414	.063115	70	.9479	.057448
80	1.0394	.062994	80	.9462	.057345
90	1.0373	.062867	90	.9445	.057242
5100	1.0353	.062745	5600	.9429	.057145
10	1.0333	.062624	10	.9412	.057042
20	1.0313	.062503	20	.9395	.056939
30	1.0292	.062376	30	.9378	.056836
40	1.0272	.062255	40	.9362	.056739
50	1.0252	.062133	50	.9345	.056636
60	1.0233	.062018	60	.9329	.056539
70	1.0213	.061897	70	.9312	.056436
80	1.0193	.061776	80	.9296	.056339
90	1.0173	.061655	90	.9279	.056236
5200	1.0154	.061539	5700	.9263	.056139
10	1.0134	.061418	10	.9247	.056042
20	1.0115	.061303	20	.9231	.055945
30	1.0096	.061188	30	.9215	.055848
40	1.0076	.061067	40	.9199	.055752
50	1.0057	.060952	50	.9183	.055655
60	1.0038	.060836	60	.9167	.055558
70	1.0019	.060721	70	.9151	.055461
80	1.0000	.060606	80	.9136	.055364
90	0.9981	.060491	90	.9119	.055267
5300	.9962	.060376	5800	.9103	.055170
10	.9944	.060267	10	.9088	.055079
20	.9925	.060152	20	.9072	.054982
30	.9906	.060036	30	.9057	.054891
40	.9888	.059927	40	.9041	.054794
50	.9869	.059812	50	.9026	.054703
60	.9851	.059703	60	.9010	.054606
70	.9832	.059588	70	.8995	.054515
80	.9814	.059479	80	.8980	.054424
90	.9796	.059370	90	.8964	.054327
5400	.9778	.059261	5900	.8949	.054236
10	.9760	.059152	10	.8934	.054145
20	.9742	.059042	20	.8919	.054056
30	.9724	.058933	30	.8904	.053964
40	.9706	.058824	40	.8889	.053873
50	.9688	.058715	50	.8874	.053782
60	.9670	.058606	60	.8859	.053691
70	.9653	.058503	70	.8844	.053600
80	.9635	.058394	80	.8829	.053509
90	.9617	.058285	90	.8815	.053424

Table A

Except for condemned tracts, rights-of-way are purchased without driving a single stake. The value of such procedure is obvious. Any right-of-way man can vouch for the fact that farmers really can at times become unreasonable if allowed to get their heads together. The land owner is unaware of the project until approached by the right-of-way man; his ire has not been aroused by a gang of surveyors trampling down crops or cutting the elm that "his grandfather carried water to" forty years ago. It is reasonable to believe that showing the farmer a picture of his property causes a certain psychological effect making him easier of approach. His interest is immediately aroused and he usually wants to know all about how the pictures were taken. In the case of absentee owners, a photostat can be mailed to him that will answer his questions such as "where does the line cross my farm and how far is it from the barn?"

By means of the aerial map, the contractor can submit a more intelligent bid; "Shooting the Moon" on things he cannot see is unnecessary. He can estimate his transportation and stringing costs more closely by knowing the location of all roads, highways, and trains. He knows where best to build his roads for construction purposes; he can schedule readily the shipment of pipe and material for shortest hauls, eliminating many delays and costs of diverting shipments; he can estimate his stream crossing expense more accurately; in fact, there is no end to which the contractor can use the aerial map to advantage.

When an engineer locates a pipeline by the usual ground method, he is confronted by the problem of satisfying not only himself but often several superiors as well. Someone is continually requesting changes, such changes sometimes having merit but quite often do not. It is difficult for anyone other than the surveyor to visualize how a line lays through an area with reference to the course preceding and the course following. Often the right-of-way has been purchased, hence the tangents of any revision must be small and the angles large. It is difficult to convince the person requesting the change that their idea is incorrect. The aerial map will show him clearly and without argument the best route to follow, thereby saving costly delays as well as added length.

The location of main line gates, drips and taps is a simple matter. Such appurtenances can be located so as to be easily accessible and the main line gates can be advantageously spaced. The photographic record of the location of the line and its appurtenances should be invaluable in the future operation of the line.

Although the actual saving in the length of the line cannot be determined, it is conservatively estimated that for the average Mid-Continent terrain, at least one-half mile is saved in every thirty miles. In rough country the saving, of course, would be greater. One might assume that in flat, open country an aerial survey would effect no saving in line length, but such is not the case. Farm houses cause more angles than rough country and there are more farm houses present in flat country. It is surprising how farm houses, orchards and school houses prevent a straight line and the seriousness of their number is not realized until one sees the aerial map. The saving effected by avoiding objectionable topographical features in one hundred miles of line is estimated conservatively at twice the cost of the aerial survey. A reduction of a fraction of one per cent in the contractor's bid ordinarily will offset the cost of the aerial survey. The actual staking of the line for construction can be done by field parties in half the time.

The possible limited speed with which the aerial survey can be conducted is the only disadvantage. Cloudless days are the only requisite but occasionally stormy periods will cause serious delays. On the other hand, one good photographic day enables the crew to photograph a double strip map of seventy-five or eighty miles of line. It is not advisable to make an aerial survey while snow is on the ground if time permits waiting until the snow melts. Cold weather does not prevent aerial photography when a heated cabin plane is used.

In this modern day of aviation development, the engineer must live up to his reputation of keeping not merely abreast of the times but just a little way ahead. Therefore, it seems plausible that he also should take to the air. The aerial camera is taking its place rapidly along with the transit and chain.

BRINGING DOWN *the* COST *of* . . . . . CUTTING OUT STUCK DRILL PIPE

By having an improved type of cutter that will make 8 to 10 more cuts per set and by being able to remove greater lengths of drill pipe at each cut you greatly reduce the time consumed in completing the job and the expense entailed when numerous trips in and out are necessary. This very obvious saving is but one of the many exclusive features of this new tool.

With the new Outside (drill pipe) Cutting Tool it is possible to cut and remove at one trip as much pipe as it is practical to wash over. The cutters are fed slowly and smoothly into the cut by a patented screw feed that absolutely prevents gouging or sticking. When cut is completed the cutters are returned by the screw feed to their original position of flush with the inside of the cutter body. There is nothing to become stuck or lodged while going in or out of the hole.

This tool is designed to prevent any upward strain on the cutters while cut is being made.

When you have a cutting job call Abercrombie. We will send an experienced operator with full equipment to perform any job. These services are available on an economical contract basis.

For RED BALL, *Inside or Outside Cutting Service Call:*

HOME OFFICE	Fairfax 5317
Long Distance 200	
Arch Owen	Lehigh 7586
H. C. Fouts	Lehigh 8445
C. M. and R. H. Abercrombie	Lehigh 6902
J. S. Abercrombie	Lehigh 7459
LAKE CHARLES, LOUISIANA	
Ford de Cordova	Phone 584

J.S. ABERCROMBIE
OUTSIDE DRILL PIPE CUTTING TOOL

J. S. Abercrombie Co.
RED BALL CUTTING SERVICE
21ST FLOOR GULF BLDG.
HOUSTON – TEXAS

When writing J. S. ABERCROMBIE CO. *please mention The Petroleum Engineer*

Some Principles *of* Oil Field Motors

By J. T. HAYWARD, *Engineer Shell Petroleum Corp.*

THE field production man is quite at home with steam engines. He can set the valves, knows what can be expected of a twin as compared with a single-cylinder engine, what the effect of altering the weight of the flywheel is, etc. With the oil field type of gas engine he is equally familiar. This understanding contributes much to the good running of these machines and to the selection of the proper type for the duties to be performed.

When it comes to electricity the situation is different,

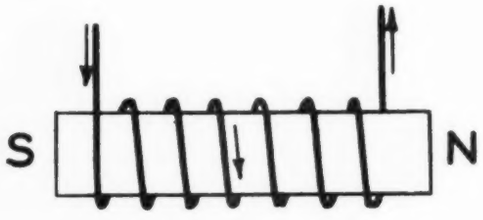


Fig. 1

and many of us do not know the why and wherefore of the various types of motor, or which to select for a given job. To ask the electrical engineer does not always bring enlightenment, owing to the technical jargon in which his answers are so often couched.

The following article is an attempt to describe in simple language the different sorts of electric motors commonly met with on the fields, and to give some idea of how they work. It is confined to the alternating current motor because this is the type in general use.

Those who know him may ask what qualifications the writer has for this ambitious task. Is it not a case of the blind leading the blind? Perhaps so, but there are situations—a London fog, for example—in which the blind can move about with greater facility than the clear-sighted, and to tell the truth there is no little fog around this motor question.

Section 1. Before describing the actual motors a few dry-as-dust paragraphs on general principles are unavoidable.

When a current is sent through a coil of wire, the coil, while the current is on, behaves as a magnet. If the wire is coiled around an iron core, the magnet is much stronger (see Fig. 1). In electrical parlance, a magnetic field has been created in the space surrounding the coil. This simply means that magnetic effects can be detected in the neighborhood of the coil. In a similar manner, when a current is sent through a lamp a light field is set up in its vicinity. A magnet of the above-mentioned type—namely, one made by sending a current through a coil of wire with an iron core—is called an electro magnet. The magnet may if desired be bent in the shape of a horseshoe, so that its north and south poles face in the same direction (see Fig. 2).

Section 2. Now for the next step. In Fig. 3 a loop of wire (A) is fixed to a shaft (B), which is free to rotate in bearings (C). Suppose the electro-magnet described in Section 1 to be moved past one side of the coil (A), as indicated by the arrow. Two things will happen. A current of electricity will be caused to flow around the loop and at the same time a drag or pull will be exerted by the magnet on the side of the loop, tending to make it follow the magnet. This pull will cause the loop and the shaft to turn in the bearings. It is very important to note here that this driving force, or pull, only exists if and when a current is free to flow in the loop. If, for instance, the loop is interrupted or broken at E, as in Fig. 4, no current can flow around it when the magnet moves past, and for this reason no pull or tendency to turn in the bearings will exist. Again, if instead of breaking the coil altogether at E, the ends be joined together by a resistance (R) (see Fig. 5), that is something which allows a current to flow, but throttles it like an orifice plate in a pipe line, the amount of current in the loop will be reduced, and the pull or driving force exerted by the moving magnet will be correspondingly less.

Section 3. The next step takes us considerably nearer to actual motors. Fig. 6 shows a number of loops mounted on a shaft. A number of magnets are mounted in a frame (F), surrounding the shaft and loops. If a continuous current be turned into the magnets and they and the frame rotated in the direction of the arrow, a pull or driving force will be exerted on the loops, and through them transmitted to the shaft. This system closely resembles real motors as used in the fields, the frame and magnets corresponding to the stator or outer part of the real motor, and the loops and shaft to the rotating part or rotor, as it is called. Of course, in the practical motor we do not rotate the frame in order to rotate the magnetic field, but what is actually done produces exactly the same effect.

Section 4. This leads us to the most difficult part of

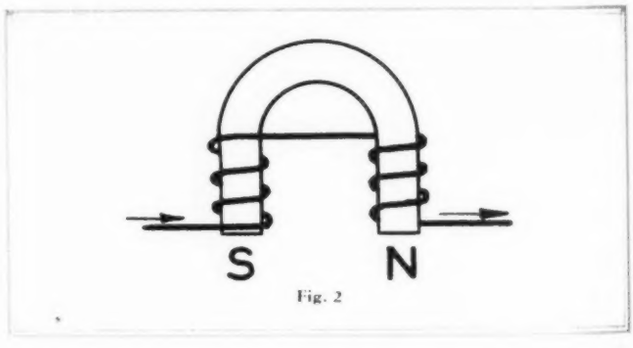


Fig. 2

the working of an A. C. motor to understand—namely, the creation of a rotating magnetic field by means of a group of stationary magnets. Let us drop dry-as-dust statements and diagrams for a while and turn for help to an illustration of a more congenial nature.

Picture a bevy of say thirty beautiful chorus girls grouped in a circle. They all face the center of the ring and their naked arms are interlaced with hands on each

See it at TULSA!

the *original* and *accepted* FAN-COOLED "EXPLOSION-PROOF" MOTOR

Booth No. 44, California Bldg., will be "EXPLOSION-PROOF" MOTOR HEADQUARTERS.

ALREADY used by 21 leading oil companies, the Louis Allis "EXPLOSION-PROOF" or type E motor will be an outstanding feature at the Tulsa petroleum exposition. Be sure to see this remarkable motor . . . originated by Louis Allis engineers 3 years ago . . . accepted almost immediately by the petroleum industry . . . the motor that made possible safe electric drive in explosive atmospheres.

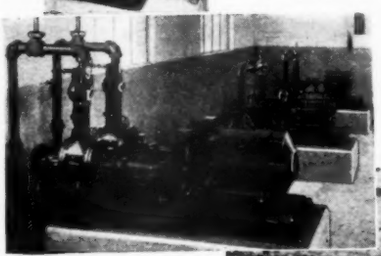
Let us explain what a genuine "EXPLOSION-PROOF" motor really is. Study the three safety features not found in ordinary enclosed fan-cooled motors. See the results of Underwriters' severe tests. Note the small size of type E motors . . . which generally fit on *stock machines* in the same space as "open type" motors.

You will see for yourself *why* type E eliminates the need of fire walls . . . why it is accepted as the modern, efficient, approved drive for refineries and natural gasoline plants . . . why leading oil companies are *standardizing* on Louis Allis "EXPLOSION-PROOF" motors for use wherever gasoline, naphtha, propane, or other volatile products are made, used, or handled.

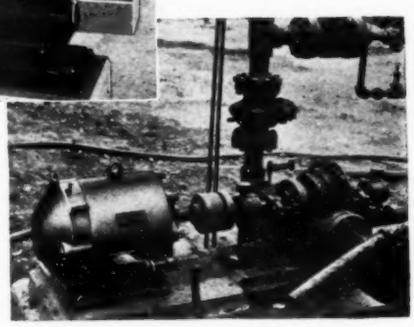
FOLLOW THE LEADERS . . .
Standardize on Louis Allis "EXPLOSION-PROOF" Motors.

On Centrifuge as used for "dewaxing."

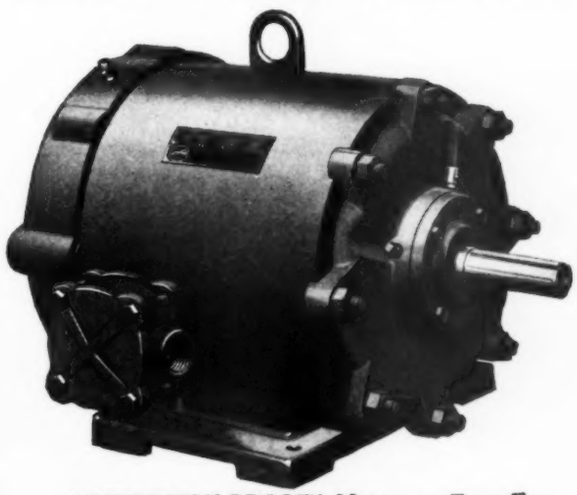
Louis Allis "EXPLOSION-PROOF" motors are widely used in Gasoline Plants and Refineries as direct drive for Pumps, Centrifuges, Fans, etc. Here are some typical installations.



In loading-rack pump-house at one of Oklahoma's largest refineries.



On pump installed outdoors at large Natural Gasoline Plant in the mid-continent.



"EXPLOSION-PROOF" Motor . . . Type E
Tested and approved by Underwriters' Laboratories for operation wherever petroleum products are made, used, or handled.
BUILT IN SIZES ¼ to 100 hp.

WARNING!

Do not confuse the Louis Allis "EXPLOSION-PROOF" Motor with non-approved so-called "vapor-proof" motors. Real "EXPLOSION-PROOF" motors must be specially constructed and must pass severe explosion tests to be approved by Underwriters' Laboratories for use in Class I explosive atmospheres.

LOUIS ALLIS

"EXPLOSION-PROOF" *Electric* MOTORS

THE LOUIS ALLIS COMPANY
MILWAUKEE, WIS.
Motor Specialists for 29 Years — *Offices in Principal Cities*

Sales Offices: Tulsa, Houston, St. Louis, Chicago, Detroit, Cleveland, Pittsburgh, New York, Philadelphia, Boston, Buffalo, Los Angeles, San Francisco . . . . and other principal cities.

others' lovely shoulders. Each girl wears a tall headdress of peacock feathers standing up fanwise above her head. They keep bowing slowly forward, until the feathers nearly touch the floor, and then bend over backward. They do not do this exactly together, each girl being a bit later than the girl on her right. An observer will see a wave traveling round and round the circle in a clockwise direction. None of the girls moves from her place, only bending backward and forward, but the resulting effect is that something moves round and round.

This illustration has not been introduced merely in a spirit of levity, nor for its intrinsic attractiveness. Besides being pleasant to contemplate, it happens to give a very faithful duplication of the manner in which the revolving field is created in an A. C. motor.

Forcing our attention back to the arrangement of magnets and coils shown in Fig. 6, an alternating current is one that bends backward and forward. It increases to a peak in one direction, then falls off and rises to a peak in the other. With three-phase current as used in the fields, there are three currents doing this, one after the other. If the magnets in Fig. 6 are connected in the correct manner to such a supply of electricity so that the state of magnetism of each is just a little out of time with its neighbor, a wave or waves of magnetism are caused to travel round and round the circle, even though the magnets themselves do not actually move around it any more than the girls did. The electrician calls this a rotating magnetic field, and the effect is to drag the loops and shaft around with it.

Section 5. We can now get on to the different types of motor actually used in the fields.

Squirrel Cage Motors. (Example: 30 H. P., 1200 R. P. M. Squirrel Cage Induction Motor.) The construction of this type motor is very similar to the arrangement of magnets and loops shown in Fig. 6. The frame of the real motor has a number of electromagnets set round it, while the rotating part or rotor consists of a number of copper loops held in slots in an iron drum keyed to the shaft. The motor got its expressive name owing to the arrangement of the copper loops, which, if the iron drum be left out of the picture, resemble to some extent a copper squirrel cage. When A. C. current is turned into the magnets a rotating magnetic field is set up, which, as already explained, will induce currents in the copper loops and drag the rotor round with it.

How fast will it turn? Perhaps the girls can help us again here. The number of times the wave will run round the feminine circle per minute will depend upon the total number of bows made per minute (which we can call the

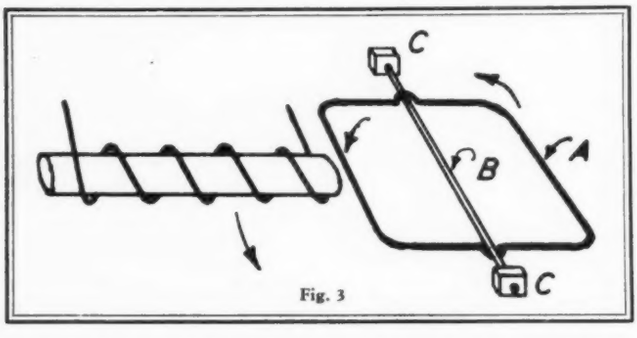


Fig. 3

frequency), and the number of girls in the ring. A little consideration will show that dividing the frequency by the number of girls will give the number of revolutions per minute of the wave. It is much the same with the motor, the number of times the magnetic field rotates in a second being found by dividing the frequency by the number of magnets, a magnet consisting of two poles, a north and a south. As the frequency is expressed in cycles per second, we must multiply by 60 to get the R. P. M. For example, in a 12-pole machine running on 60-cycle current the field will revolve at the rate of:

$$\frac{60 \times 60}{\frac{12}{2}} = 600 \text{ R. P. M.}$$

If this same motor be installed in California where the frequency is 50 cycles per second, its synchronous speed becomes:

$$\frac{50 \times 60}{\frac{12}{2}} = 500 \text{ R. P. M.}$$

Under no load the rotor will be pulled round at practi-

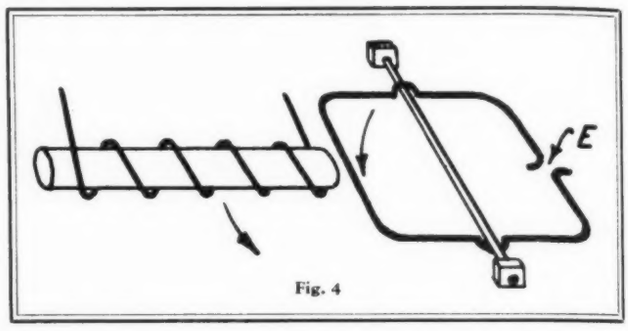


Fig. 4

cally the same speed as the field, the magnetic drag being very powerful. When the motor is made to drive a load, there will be a certain amount of slip between the revolving field and the rotor, just as there is when a belt drives a pulley under load. At full load this slip usually amounts to about 30 R. P. M. That is why the full load speed of a 12-pole motor running on 60-cycle current is given as 570 R. P. M. on the nameplate.

The squirrel cage motor suffers from the limitation that its speed cannot be varied, and it is not adapted to such operations as drilling, cleaning out, or servicing a pumping well. When used on beam pumping wells, pulleys or sprockets must be selected to give the correct speed, and changed whenever it is required to alter the number of strokes per minute. Owing to the advantages enumerated at the beginning of this section, this motor may be selected for all duties in which its variable speed limitations do not exclude its use. It is well suited for compressor and centrifugal pump drives, and for beam wells at which proration requirements can be met by intermittent pumping, and/or varying the stroke, as rods and tubing cannot conveniently be handled with a constant-speed motor.

Section 6. Variable-Speed, Single-Speed, Slip-Ring Motors. (Example: 75 H. P., 720 R. P. M. Wound Rotor Motor.) This is an impressive, though at first sight a puzzling, title. It is the type of motor generally used for cable tool and rotary drilling.

It will be remembered that in Section 2 it was shown that the magnetic drag exerted on the rotatable loop of wire by the moving field was exerted only when current was free to flow round the loop. If the loop was cut at some point no pull was exerted, and if a resistance was placed in the gap the driving force depended upon how much current this resistance permitted to flow in the loop. This is the method by which the speed of these motors is varied. The loops are cut and their ends connected to slip rings mounted on the shaft. Brushes rub on these slip rings and leads from these brushes go to the controller

Approximately 85% of the oil produced in the Oklahoma City area is pumped away to refineries or main pipe lines with Electric motor-driven pumps. — a fact certifying to the efficiency of ELECTRIC POWER.

BYLLESBY
OKLAHOMA GAS AND ELECTRIC COMPANY
PIONEERS IN PUBLIC SERVICE

ELECTRIC COMPANY

Courteous, Personal Attention to Every Customer

Oklahoma City, Okla.

When writing Oklahoma Gas & Electric Co. *please mention The Petroleum Engineer*

(see Fig. 7). The controller is a device for putting various resistances between the ends of the leads coming from the brushes, which is equivalent to putting resistances in the loops themselves. When the juice is turned on to the electromagnets and the revolving field set up, currents are induced in the loops, the circuit being round the loop to the slip ring, from it, by way of the brush and lead through whichever resistance happens to be switched in by the controller, and back through the other lead, brush, and slip ring, to the loop.

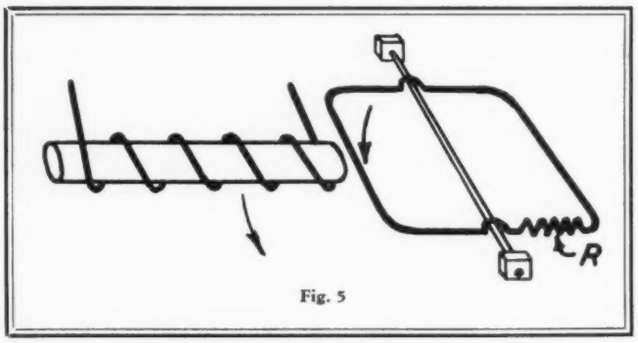


Fig. 5

It is important to note that the field always rotates at the same speed, depending only on the frequency of the supply and the number of poles, and that the variation in speed of the rotor is obtained by weakening the pull of the rotating field on the loops of the rotor, and allowing the slip to increase. The actual speed will therefore depend upon the load as well as the position of the controller. What we are really doing when we put in resistance with the controller is to weaken the motor so that the load can slow it down. With all the resistance out—that is, on the eighth or tenth point—the motor will behave very much as a squirrel-cage motor, i. e., it will hold to nearly full speed, whatever the load, but as the controller is moved toward the first point the motor becomes very weak and sensitive to changes in load. Under very light loads it will still run full speed, even on the first point, but any increase in the load will cause the speed to fall to a much lower value. In Section 5 it was stated, in illustration, that the revolving field drives the rotor very much as a belt drives a pulley. Turning the controller toward the first point is much like moving the idler pulley on a belt drive and slackening the belt. It allows the slip to increase and the driven pulley (or rotor) to slow down under load.

Now, slip means waste of power, and it is important to remember that as the speed of this type of motor is reduced, the efficiency falls off in a corresponding ratio. If, therefore, the efficiency of a certain slip ring (wound rotor) motor is 90 per cent at full speed, its efficiency at half speed will be only 45 per cent. This means that when the speed of a 900 R. P. M. motor, for instance, is cut down to 450 R. P. M., 55 per cent of the power paid for and put into it is wasted. During such operations as drilling or servicing a well, low efficiency may be a matter of secondary importance, but for pumping or any other continuous operation where economy is sought, sprockets and pulleys must be chosen so that the motor runs as close to full speed as possible, and variations in production for potential purposes should, as far as they can, be made by alterations in the pulley ratios, intermittent pumping or changing the stroke.

While discussing this type of motor it may be worth drawing attention to the fact that power consumption of such operations as drilling cannot be accurately determined from the wattmeter or ammeter readings, as these instruments record the input to the motor, and, for the reasons given above, the *output* cannot be arrived at unless the speed also is known.

Section 7. Variable-Speed, Two-Speed, Oil Well Type Motor. (Example: 25/55 H. P., 600/1200 R. P. M. motor.) Here again is a curious-looking title. This type of motor is the equivalent of two motors rolled into one. The motor given in the example above, corresponding with a 25 H. P., 600 R. P. M., variable-speed motor, combined with one of 55 H. P. and 1200 R. P. M. The words "two-speed" in the title refer to the fact that in this motor there are two synchronous or full speeds; in other words, the field can be caused to rotate at two different rates. In Section 5 it was shown that the speed of rotation of the field depended upon the frequency and the number of poles. We cannot vary the frequency, it being determined by the supply, but we can alter the number of poles. The oil field two-speed motor is built as a twelve-pole machine, but the winding of the stator is so arranged that by moving a switch two adjacent dissimilar poles can be combined into one, making it a six-pole machine. This, with 60-cycle current, gives 600 and 1200 R. P. M. as the two speeds at which the field can be caused to rotate, and there will be of course two corresponding full or synchronous speeds for the rotor. To get more than two groupings of the poles leads to technical difficulties in the design, so further speed variations are got by sliprings and resistances, as in the wound rotor motor described in Section 6, but six slip rings are required so that the arrangement of the loops shall be correct for both pole groupings.

The practical difference between the single-speed, variable-speed, and the two-speed, variable-speed motor is that the latter has two comparatively efficient speeds. Suppose, for example, that at a pumping well we require 50 R. P. M. at the crank for pulling and 25 R. P. M. for pumping. If the single-speed, variable-speed motor were used for this duty it would during pumping be running with 50 per cent slip, and therefore wasting more than half the power consumed. In addition it would be running in the unstable part of the speed range and subject to wide variations as the pumping load varied, and to running away if the rods parted. Using the two-speed motor, it would be switched over to the 600 R. P. M. side and run close to synchronous speed, with corresponding efficiency and speed stability.

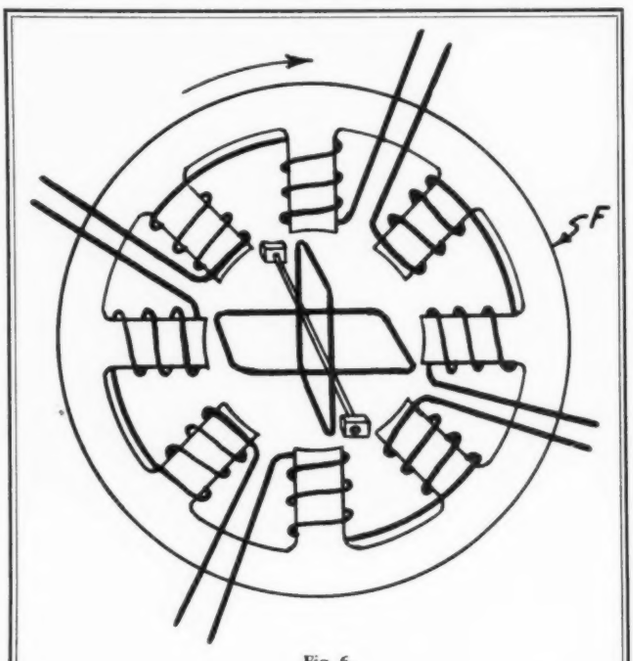


Fig. 6

THE NEW LUCEY TYPE A-14000

Fully Enclosed

OIL BATH ROTARY

Just what the industry has expected of Lucey—an ultra-modern machine with entirely new features that will eventually become the standard of rotary design.

LUCEY

"WHEREVER THERE'S OIL"

Opening through table, 26 inches.
Outside diameter of table, 58¾ inches.
Height over all, 29 inches.
Height above skids, 18 inches.
Width of base, 48 inches.
Length of base, 106½ inches.
Diameter of pinion shaft, 6 inches.
Net weight, 11,545 pounds.

LUCEY PRODUCTS CORPORATION

DOMESTIC HEADQUARTERS
224 EAST BRADY STREET TULSA OKLAHOMA

BRANCHES

OKLAHOMA CITY OK · DUNCAN OKLA · MAUD OKLA · SHREVEPORT LA · HOUSTON, TEXAS · LOS ANGELES, CALIF.

EXPORT

3505 WOOLWORTH BUILDING NEW YORK CITY
54 OLD BROAD STREET LONDON E C 2 ENGLAND
55 RUE DE RIVOLI (1 ER) PARIS, FRANCE
PLOESTI, ROUMANIA
SAN FERNANDO, TRINIDAD, B. W. I.
DIAGONAL ROQUE SAENZ PEÑA NO. 501 BUENOS AIRES, ARGENTINA, S. A.

When writing LUCEY PRODUCTS CORP. *please mention The Petroleum Engineer*

The disadvantages of the two-speed oil-well type of motor are its high first cost and its poor power factor (explained below) on the low side, but in spite of these, under field operating conditions such that a squirrel cage cannot be used, owing to varying speed requirements, it has proved a very suitable type of motor.

Section 8. In addition to the motors described above, there are a number of other types to be found occasionally in the fields. One of these is the Y-Delta motor, so called because the alternative wirings resemble, when drawn diagrammatically, a Y and the Greek letter △. This motor may be either of the slip-ring or the wound-rotor single-speed, variable-speed type. Example: 20/50 H. P. 1200 R. P. M. squirrel cage. This corresponds to two squirrel cage motors, one of 20 H. P. and one of 50 H. P., but both of 1200 R. P. M. combined in one. Second example: 25/65 H. P. variable speed motor. This is equivalent to two motors of different horsepower, but both of the same synchronous speed, rolled into one. The province of the star-delta motor is where extensive running at reduced loads, but full speed, is done. Under such conditions a motor with two horsepower ratings can be run more efficiently and with better power factor than a single-rated motor.

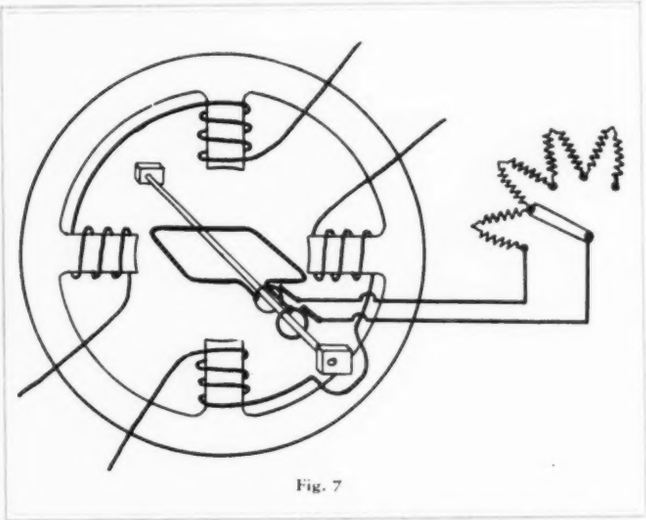


Fig. 7

There are several other types of motors, but as they are infrequently met with in the field their description is omitted.

Section 9. Power Factor. This is a difficult subject—perhaps the most confusing in electrotechnics that the field man comes up against. The theory involves vector analysis, while the analogies often substituted are nearly as difficult to comprehend as the conventional textbook treatment. The following exposition, while in many ways unsatisfactory, will probably serve for everyday purposes.

When an electro magnet is energized by an alternating current it behaves in the following manner: While the voltage or pressure in the feeders is increasing, the magnet stores some of the current and empties it back again into the lines as the pressure dies away. This cycle occurs, of course, many times per second, corresponding with the frequency. The A. C. motor contains magnets, and, in addition to the current that is consumed and converted into power in turning the motor, there is a certain quantity that flows in and out of the magnets. This is often referred to as the magnetizing current. As this current just surges backward and forward through the feeders, high lines, etc., it does not require power to generate it, and it does not record on the wattmeters that measure the power actually used and from which the power bills are calculated. At first sight, therefore, it might be concluded that this magnetizing current is not worth considering, but this is far from being the case. It has to be remembered that the high lines, transformers, feeders, generator windings and all the rest of the equipment have to carry this magnetizing current, and have to be sufficiently large to carry it, as well as the useful working current, without undue heating and voltage drop. This means extra capital investment.

Energy losses, due to voltage drop caused by choking the lines, etc., with this magnetizing current, which occur on the consumers' side of the wattmeter, will be directly supported by him. In addition, in some localities the power company increases the power bill to compensate it for the investment in extra transmission equipment required to carry the magnetizing current. It is charged at a lower rate than the useful power current because it requires no horsepower to generate it (aside from the losses), but the additions to the bills may be of sufficient magnitude to weigh with the consumer in the choice of motor equipment.

The amount of magnetizing current required by a motor depends mainly upon its type and size, and is therefore practically constant, whatever the load on the motor. If the load is small, compared with the rating of the motor, the useful current converted into power will be correspondingly small and the magnetizing current may, therefore, be quite large in comparison. For example, if a 30-H. P., 600-R. P. M. squirrel cage motor be run on a 15-H. P. load, the magnetizing current will be about 40 per cent of the total. The current converted into work will, therefore, be only 60 per cent of that flowing in the lines, etc., and this is what is meant when the power factor is said to be 0.6 or 60 per cent. The total current in a circuit is expressed in kv-a and that delivered to the load in kw, so that

$$\frac{\text{kw}}{\text{kv-a}} = \text{power factor}$$

It is, therefore, not economical to run a large motor (even at full speed) on a light load for any considerable length of time, on account of the power factor and the nameplate demand charge additions to the bill.

As a general rule, the higher the rated synchronous speed of a motor, the better the power factor.

The power factor in the supply system is not imposed upon the motor, each motor power factor depending only upon its own characteristics.

Section 10. Capacitors. Static condensers, or capacitors, as they are called, are often used in the field to improve the power factor by supplying the magnetizing current to the motors. Being placed close up to the motor they keep this current out of the distribution system. We saw in the last section that the magnetizing current surges in and out of the motor magnets. If something that can absorb, store, and give back these surges is placed on the feeders close to the motor, it will keep them out of the rest of the system. A static condenser is such a device and consists of thin metal plates of large area rolled up and separated by a sheet of insulation. It cannot, of course, generate power, but just stores the oscillating current for a fraction of a second and gives it back again. Whether to install capacitors or not will depend, in the first place, upon the terms of the power contact, and in the second place on the length of the feeders and amount of equipment on the customers side of the wattmeter.

Space does not permit the discussion here of transformers, controllers, switch gear, etc. To dispose of these would entail cutting out some other part to make room, and this pruning would probably involve the girls. Faced with these alternatives, the decision is easily made.

3 TESTS FOR EVERY NORDSTROM VALVE.

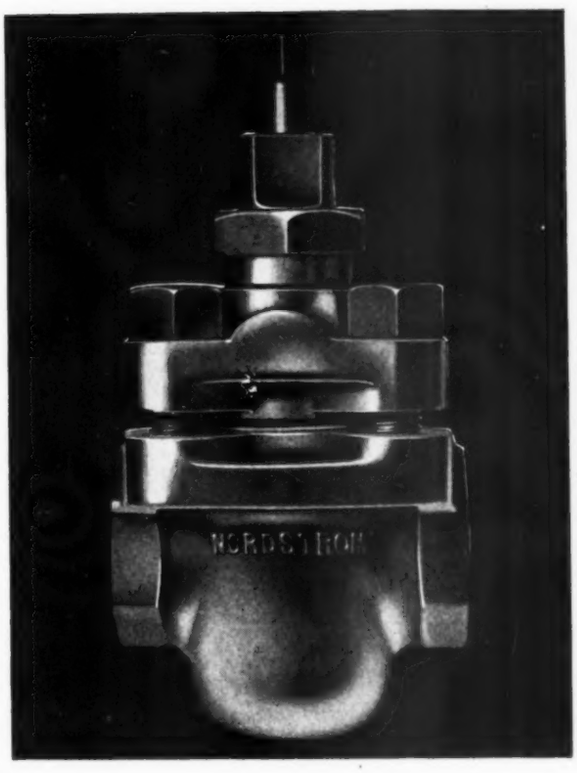
See our exhibit at the International Petroleum Exposition and Congress, October 4 to 11 at Tulsa, Oklahoma.

Nordstrom Valves will withstand pressures **double** the rated cold working pressure because they are subjected to a hydrostatic test of such severity in the factory.

A primary air test at 75 pounds air pressure discovers any porosity of the body castings. A secondary air test at 150 to 250 pounds air pressure indicates any leakage when the valve is completely assembled.

Thus every Nordstrom Valve must pass severe requirements far in excess of those actually met in operation. This is **your** guarantee of most efficient valve service and long life.

Nordstrom Valves are leak-resistant and always easy to turn because sealed and lubricated by the patented "Sealdport" method of lubrication, which employs hydraulic pressure and special "Merco" Lubricants.



Nordstrom Valve with "Sealdport" method of lubrication.

Ask for Latest Catalog

MERCO NORDSTROM VALVE COMPANY

SUBSIDIARY OF THE MERRILL COMPANY . . ENGINEERS

Atlanta - Healy Bldg.
Boston - 184 Boylston St.
Buffalo - Genesee Bldg.
Chicago - 176 W. Adams St.
Dallas - Magnolia Bldg.
Detroit - 2842 West Grand Blvd.
El Paso - 111 So. Virginia St.
Houston - Petroleum Bldg.
Los Angeles - 556 So. San Pedro St.
New Orleans - Masonic Temple Bldg.
New York - 11 W. 42nd St.
Pittsburgh - Clark Bldg.
St. Louis - 317 N. Eleventh St.
San Francisco - 343 Sansome St.

Agencies:

Denver - Republic Supply Company, 332 Continental Oil Bldg.
Honolulu - W. A. Ramsay Co., Ltd., Fort & Queen Streets.
Manila - E. W. Sharp, c-o J. A. Murphy Co. Perez Semanillo Bldg.
Philadelphia - Brown, Wilson & Company, 1600 Arch St.
Saginaw - Arthur C. Beckert, 112 Durand St.
Salt Lake City - National Equipment Co., 101 West 2nd South St.
Tulsa - B.V. Emery & Company, 216 E. Brady Street

Factories in U. S. Oakland, Calif. and Belleville, N. J.
Canada - Peacock Bros., Ltd., Montreal, Toronto, Winnipeg, Vancouver. (Also Sydney, N.S.)
England - Audley Engineering Co., Ltd., Newport, Shropshire.
Buenos Aires, Argentine, - General Electric, Soc. Anon., Victoria 618 Esq. Peru.

For best valve service, use "Merco" Lubricants. For a permanent seal in screw thread and gasketed joints, use "Merco" Pipe Compound.

MERCO

THE PERFECT APPLICATION OF A PRINCIPLE

When writing MERCO NORDSTROM VALVE CO. *please mention The Petroleum Engineer*

Progress *of* Major Pipe Line Work

The Great Lakes Pipe Line system.

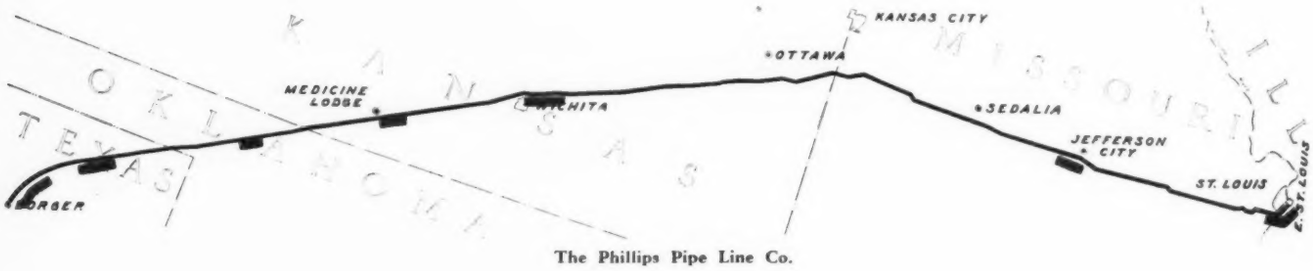
ABOUT two years ago when pipe line construction was at its zenith in West Texas with the building of half a score oil trunk systems, and large gas transmission systems were being pushed into new marketing territories, the total investment and amount of work involved prompted many to herald the era as possibly the greatest in pipe line construction the industry would ever witness. The present year, however, has changed the picture greatly, and if many of the projected gas lines now in the process of formation are started this year it will mean that a new record for pipe line investment will be established.

As the changing picture now stands work representing more than a quarter of a billion dollars has been either started or completed this year. This total is constantly swelling with the completion of expansion programs on old lines and at pumping and compressor stations. It is important, too, that pipe line building has brought about the advent of several new construction companies and at the same time has been a great factor in giving steel mills a great share of business, which permits them to operate on a full-time schedule.

The construction program this year covers the full range of oil industry transportation from crude petroleum to the most volatile form of refined products. This year companies which heretofore have not been major factors in the transportation branches of the industry, have invested heavily in pipe lines to move refined products to distant markets from refineries located close to their source of supply. Two major crude oil carriers are under construction and two others are in the formative stages.

Gas transmission systems represent the greatest part of this year's construction program and three of these major lines originate in the Texas Panhandle. Gas lines also represent the most pipe line work in both the East and West and considerable more construction work is planned for the Southwest and Northwest.

Maps of eight of the major pipe lines under construction are published in this issue of The Petroleum Engineer.



The Phillips Pipe Line Co.

The Gulf Pipe Line Co.

These maps, which will show graphically the progress of the major carriers from month to month, will be a regular feature of this magazine.

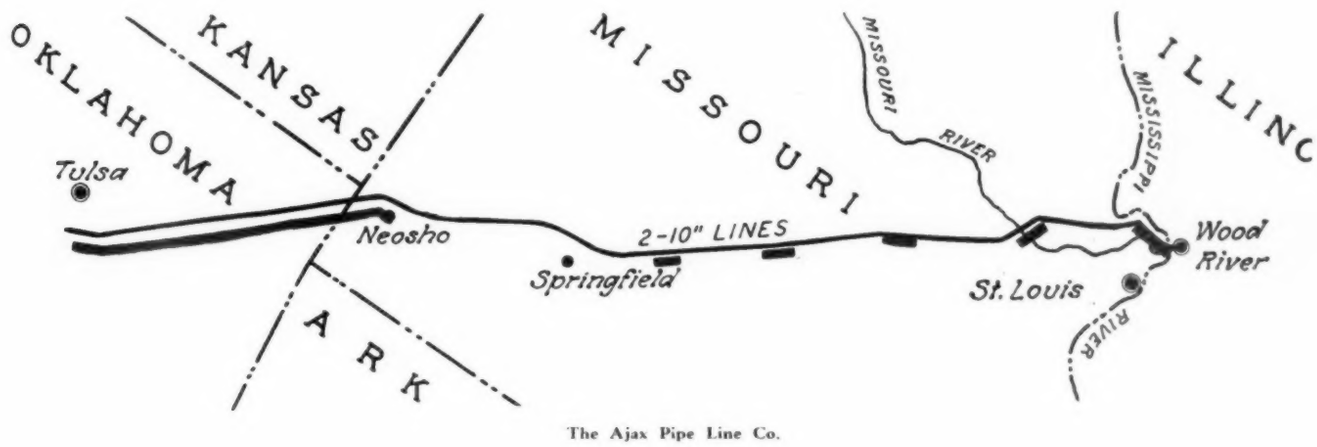
Of the gasoline lines, that of the Great Lakes Pipe Line Co., of Ponca City, Okla., will be the longest, and will start operation with a capacity of approximately 40,000 barrels daily. This line continues to grow in magnitude and its size from Tulsa to Barnsdall has been increased from 6-inch to 8-inch pipe. The line north from Des Moines, Iowa, has been increased from 4-inch to 6-inch, and a 70-mile, 4-inch lateral has been started from El Dorado, Kans., east to intersect the main line.

Construction work is getting well under way and approximately three per cent of the entire 1,440 miles of main line is in the ground. Contracts have been awarded for the various sections over the line, and the company expects to have the line complete and in operation as far north as Kansas City, Mo., by Christmas.

Phillips Pipe Line Co., transporting subsidiary of the Phillips Petroleum Co., is well along with construction of its 8-inch line from Borger, Texas, to St. Louis, Mo., with over 10 per cent buried and seven crews working at various points. This line is unusual because its stations will drive centrifugal pumps with gas engines. The engines will be fueled with butane, which will be slugged through the line in a liquid form and later vaporized for fuel. It is expected that the line will be completed by the first of the year.

In the East, the Sun Oil Co., through a transporting subsidiary, is well along with the work on its high-pressure gasoline line.

Both the Gulf Pipe Line Co. of Penn. and the Ajax Pipe



The Ajax Pipe Line Co.

The Continental Construction Co. line.

Line Co. (Standard of New Jersey subsidiary), are well along with construction of their crude oil lines. The Ajax system is a double 10-inch carrier running out of the Mid-Continent from a point near Jenks, Okla., to Wood River, Ill. Approximately 50 per cent of the work on the welded lines has been completed.

Gulf Co.'s 10-inch welded line is moving along rapidly, with much of the stream crossing work out of the way and the construction crews working on the cross country stretches. More than 245 miles of the line has been put into the ditch.

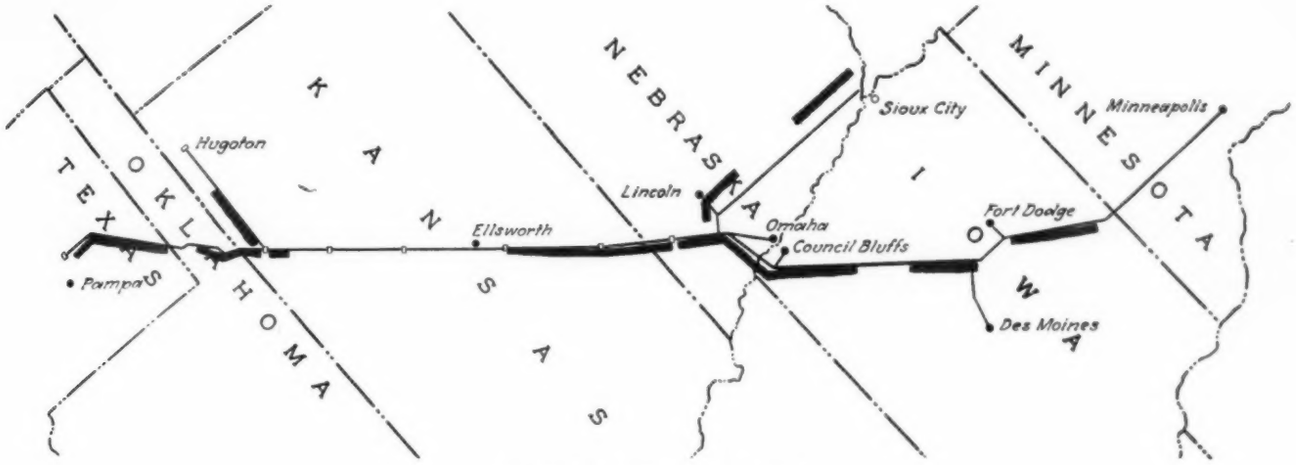
Construction of the 24-inch $100,000,000.00 gas line, being built for the group of companies by the Continental Construction Corp. from the Texas Panhandle to Chicago, will move along speedily in the future. Approximately 70 miles of pipe is in the ditch and contracts have been awarded for virtually all of the work.

Missouri-Kansas Pipe Line Co., building from the Panhandle to Indianapolis, Ind., has 230 miles of pipe buried and will have completed its 50-mile gathering system in the Panhandle by October 15. In addition to it, the company has a main line extension running south from Terre Haute into Kentucky and approximately 60 miles of this line is in the ground. Ten crews are rushing the completion of the Indianapolis line.

Missouri Valley Gas Co. is well over half through with its gas line from the Panhandle and expects to complete its 920 miles of main line work by the end of this year. Crews are working in Texas, Kansas, Nebraska and Iowa.

Southern Natural Gas Corp. is winding up work on its

The Missouri-Kansas Pipe Line Co.



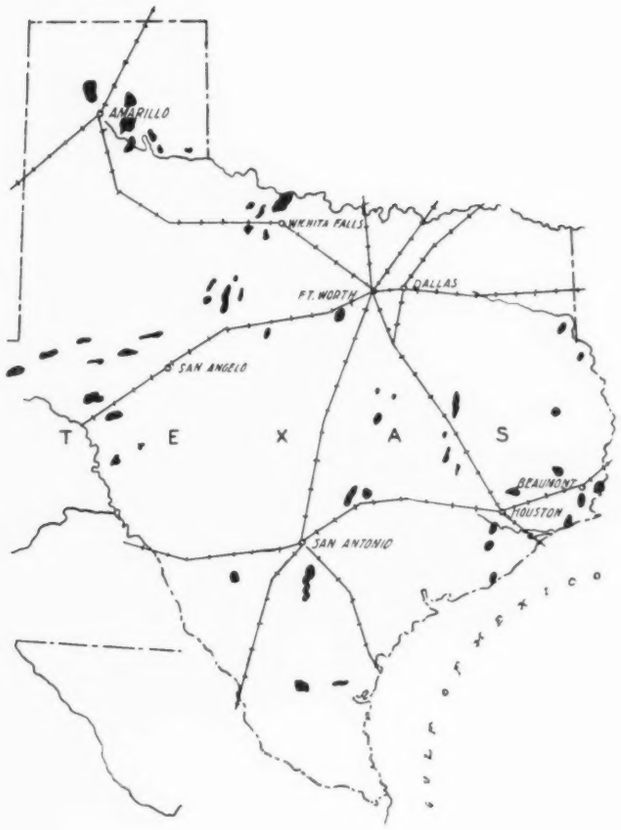
The Missouri Valley Gas Co. system.

700 miles of main line extension in the South and will have the lines in operation before the arrival of the first cold snap. A 12-inch lateral is going from the Mobile main line to Pensacola, Florida, and this will mark the first entry of a natural gas line into that state.

Most of the pipe line companies adding additional capacity to their stations expect to have all of this work completed by the end of October, and the companies carrying on reconditioning work have about completed their summer programs.

The Southern Natural Gas Co. system.

LATEST ACTIVITIES *in the* • OIL FIELDS •



Texas

THE San Antonio region of the Balcones fault area is showing an increased amount of activity and interest. Most of the completions and attention has been in the Pettus field. Hopes of additional production in this territory were enhanced the past month with the apparent discovery of a new gas field about twenty miles southeast of Pettus.

The Refugio field in the Gulf Coast area is holding the eyes of this region. The past month a new deep producing horizon was encountered by the Independent Oil & Gas Company in a test carried to 6,714 feet. A one-half mile southeast extension was added to the 6,400-foot producing horizon by an 800-barrel well. Most of the recent completions in this field have been in the deeper producing horizons.

The Humble dome was further proven by new productive area found on its west flank.

In the Permian Basin a producer of 1,500 barrels was completed between the Leck and Hendricks pools of Winkler county. The success of the deep completions in the Big Lake pool continue to be of much interest.

California

The large proven producing area of the Kettleman Hills field was given another big extension the past month when the Superior Oil Company's Hoffman 1, approximately four miles west of production, came in for 7,500 barrels. The north dome of the Kettleman area now measures 10 miles east and west between production.

A new oil pool was found in Kern county, about 15 miles southeast of Bakersfield. A wildcat test in this location found 250 barrels of production at 5,370 feet.

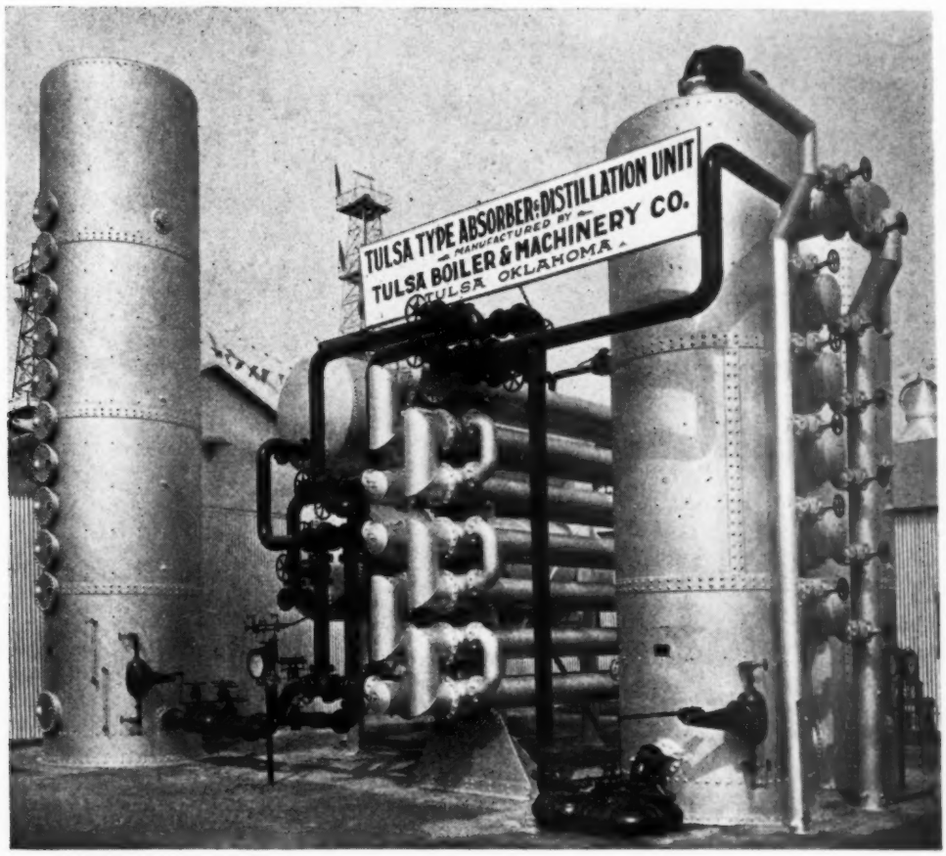
There were a number of completions in the Playa Del Rey field of the Los Angeles Basin. These resulted in an increase in the number of drilling wells, but it will probably be some time before the peak of drilling is reached in the pool. The completions at Playa Del Rey, and also at Elwood, including several large tidewater location producers. Production at Playa Del Rio reached a peak of 23,000 barrels from 33 wells late in September, but was expected to more than double this amount in a short time, as at least that many more tests should be completed shortly.

Oklahoma

General drilling activity throughout the state is subsiding due to enforcement of heavier restrictions upon crude oil production and the general crude situation.

The most important development in Oklahoma the past month was the discovery of production west of Edmond, about 20 miles north of the Oklahoma City field. A wildcat test of Mid-Kansas Oil & Gas Company and Ramsey Petroleum Corporation is flowing about 450 barrels of oil per day from 6,766 feet in the Wilcox sand horizon. It is

1929



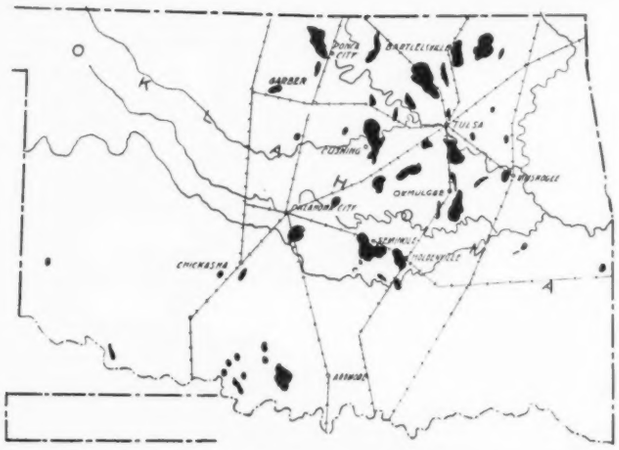
What ? IMPROVEMENTS will TULSA TYPE introduce to the Industry in 1930-1931

Visit Our Exhibit on Lot "L"

Tulsa Boiler & Machinery Co.

Tulsa, Oklahoma

When writing TULSA BOILER & MACHINERY CO. *please mention The Petroleum Engineer*



gradually being deepened and thus far has increased its production with deepening.

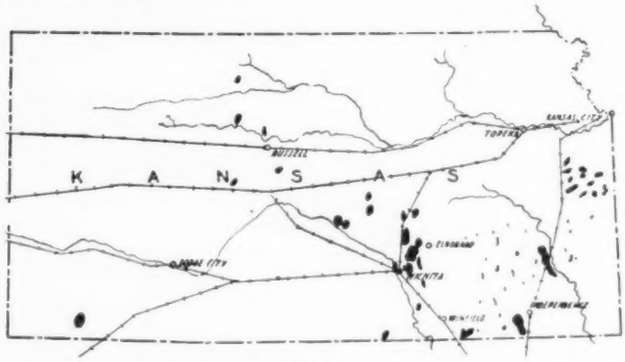
Completion records in the Oklahoma City pool continue to run unusually large. There are but few new tests being started. The intense drilling campaign there is drawing to a close. Most of the recent completions have lacked the enormous output of the earlier wells, due mostly to sharp declines in the rock pressure of the area. Several near failures were found on the edges of the pool, especially in the south end.

A new producing horizon was found in the old Cement field of Caddo county, where a 1,000-barrel well was finished.

Inspection of the West Asher and Chandler pools, the two active spots outside of Oklahoma City, shows nothing unusual.

Kansas

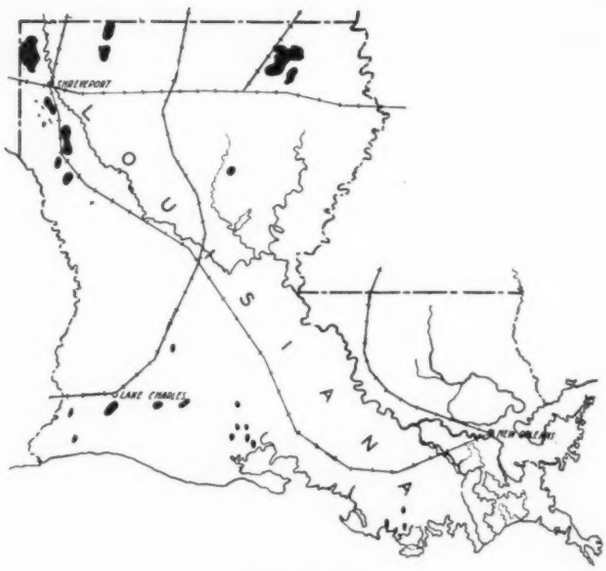
Western Kansas wildcats continue to be of big interest in this state. A wildcat test, belonging to Shell Petroleum Corporation, in Rice county, is estimated good for 5,000 barrels. A 16,000,000 wildcat gasser was completed in Reno county at 3,320-30 feet. First well in Stafford county is a commercial producer in small quantities. It is 25 miles from nearest production.



Eastborough field, near Wichita, is now the most active spot in the state. This pool was extended one location by second completion in Wilcox sand making 1,565 barrels.

Schurr pool in Rice county was extended one-quarter of a mile west by 400-barrel well of The Texas Company.

The Hugoton gas area in extreme southwest sector is undergoing an extensive development and now has an unusually large producing area proven.



Louisiana

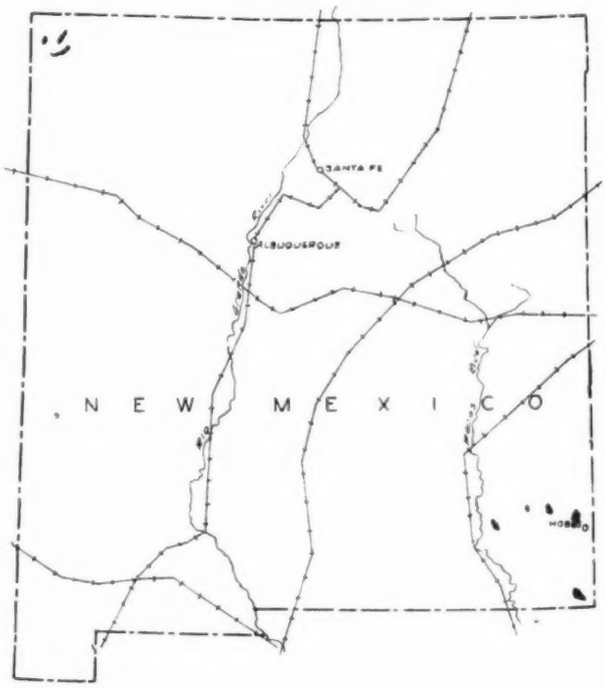
The Zwolle field was extended one mile south by a 1,200-barrel well. A well was found 10 miles southwest of Holly production in De Soto Parish.

Arkansas

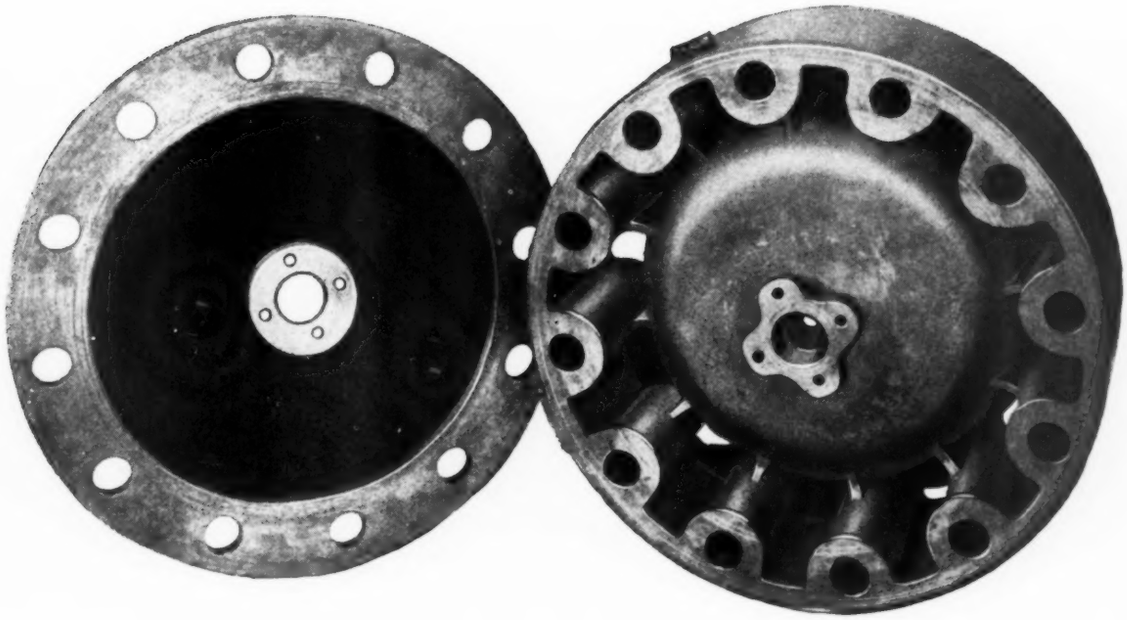
The Urbana field is the most active in Arkansas. In this state operations are at the lowest level in years.

New Mexico

The Hobbs field, Lea county, southeastern New Mexico, continues to draw attention to this state. This field has approximately 100 drilling wells, and a potential production of more than 300,000 barrels daily already. The past month saw its producing area extended in several directions by large wells. Undoubtedly this field will be a big factor in the crude oil market of the Mid-Continent this winter.



Replace Gas Engine Heads



with the "Improved"
STEEL GAS ENGINE HEAD

Eliminates cracking of heads

◆

Increases water space

◆

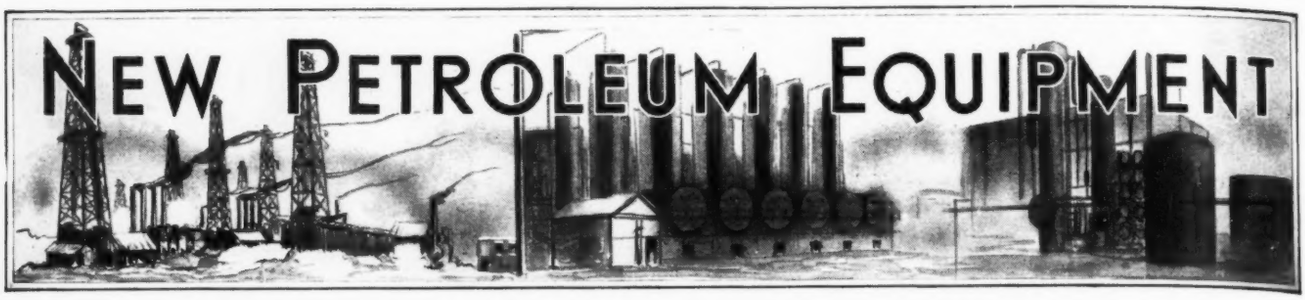
Saves fuel, oil, piston rings and cylinder walls

This IMPROVED STEEL GAS ENGINE HEAD will eliminate the high maintenance costs, renewals and shutdowns experienced by the use of other engine heads. The combustion chamber is built of electric cast steel with integral skeleton frame... annealed to prevent warping and cracking in service. Weight has been reduced without sacrificing strength. Construction of the removable head plate allows for increased water space and is sufficiently flexible to counteract the vibration to which it is subjected. Uses less circulating water. Expansion and contraction are amply provided for. "IMPROVED" heads are made to fit either right-hand or left-hand cylinders.

IMPROVED STEEL GAS ENGINE HEAD CO.
3428 South Santa Fe Ave. West Tulsa, Okla.

See Our Exhibit at the Exposition in Booth No. 33, Texas Building

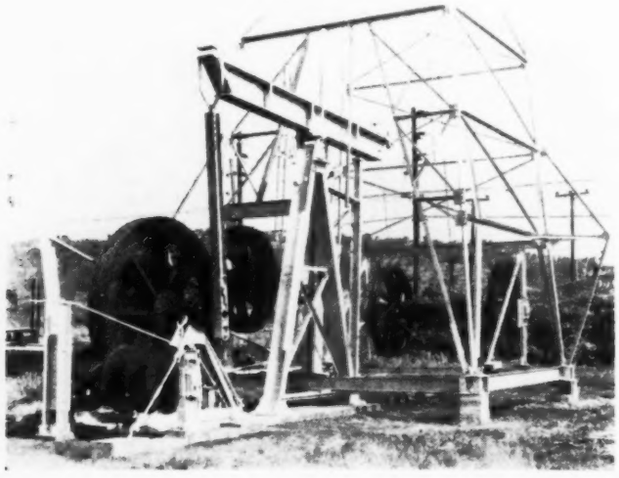
When writing Improved Steel Gas Engine Head Co. *please mention The Petroleum Engineer*



New Moore Steel Ring Fronts

LEE C. MOORE & COMPANY, INC., of Pittsburgh and Tulsa, has added two new steel rig fronts to its line of manufactured equipment.

These new rig fronts, known as Types 90 and 91, are of "A" frame, all-steel construction. In addition to heavy



bracing, welding has been employed to add to the strength and rigidity of the equipment. Both types are designed for heavy duty.

Black, Sivalls & Bryson, Inc., Has New Division

ANNOUNCEMENT has been made of a Refinery and Gasoline Plant Division of Black, Sivalls & Bryson, Inc., tank manufacturers and steel fabricators of oil field equipment, with general offices in Bartlesville, Okla.

The new division offers a complete service to the refiner and natural gasoline manufacturer in designing, manufacturing and constructing their essential equipment. The work is supervised from the original plans to the entire plant, complete, ready to operate.

The actual manufacture of the pressure vessel welded tanks and other equipment is produced in the factory of the American Tank and Equipment Corporation of Oklahoma City, which concern is the manufacturing subsidiary of Black, Sivalls & Bryson. This company has just recently moved to its new and modern factory, an all-welded building, one of the few, and among the largest of its kind in the country. A staff of seventeen engineers are employed to render services in the refinery and natural gasoline plant division. This includes engineers who have specialized in the design and manufacture of refinery and gasoline plant equipment.

The equipment being designed and manufactured includes for refiners: Storage tanks, agitators, acid towers, condenser boxes, heat exchangers, seriators, stills, smokestacks, breeching, etc., and for natural gasoline plants, fractionating units, bubble towers, scrubbers, non-absorbers, absorption towers, debutanizers, storage tanks, stabilizers, etc.

New Westcott Gasketless Drilling Gate Valve

WESTCOTT VALVE COMPANY is offering a new drilling gate valve, which embodies several improvements and features. The new valve has no gaskets, eliminating replacement of gaskets when damaged. It is leakproof—the joints are ground and tapered.

The disc is of solid wedge type with Westcott's tee head in connection with the stem. The wedge is free and floating until seated. The tee block or nut is of Manganese bronze with the bottom forming a ball and socket at the top of the wedge. At opening, the tee head is the strongest part and completely obviates any chance for stripping during this very dangerous operation. The stem pushes the wedge

firmly into the seat, but does not guide the disc, leaving it free to seat firmly. No bushings of any character are used between the stem and wedge disc.

The many more details of this new valve may be obtained from the Westcott Valve Company, East St. Louis, Ill.

SAFETY FIRST . . . .

COMES WITH SAFE EQUIPMENT . . . .

There probably is no industry where the rule of Safety First is more vitally important than in the petroleum industry. Look at the "caution" signs around a distributing station, pipe line pumping station, refinery or a drilling unit. These signs are a constant reminder that there cannot be a surplus of safety—a surplus of protection against a disastrous fire.

But these signs are of little avail if safe equipment is not used also. Motor starters, for example, should provide complete protection against a fire. EC&M Motor Starters provide this protection—every main contact operates under oil and overload contacts are supplied to open and close the circuit, either under oil or in a sealed vacuum. Push buttons are also of the oil-immersed or vapor-proof type.

EC&M manufactures a complete line of flameproof motor starters and controllers. They are described in Bulletins 1042-G, 1047-A, 1048-P and 1062. Write our nearest branch office for your copies.

Visit Our Booth, Space No. 55, California Bldg.
International Petroleum Exposition, October 4-11

THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND, OHIO

NEW YORK-50 CHURCH ST.
CHICAGO-CONWAY BLDG.
DETROIT-DIME BANK BLDG.
BIRMINGHAM-BROWN-MARX BLDG.
CINCINNATI-1ST NATIONAL BANK BLDG.
ST. LOUIS-422 A CASTLEMAN AVE.
LOS ANGELES-912 E. THIRD ST.
HOUSTON-P.O. BOX 4182
TORONTO-REFORD BLDG.
PHILADELPHIA-WITHERSPOON BLDG.
PITTSBURGH-OLIVER BLDG.
SAN FRANCISCO-CALL BUILDING
MONTREAL-CASTLE BLDG.
TULSA-217 E. ARCHER ST.
SEATTLE-ALASKA BLDG.

When writing THE ELECTRIC CONTROLLER & MFG. CO. *please mention The Petroleum Engineer*

Ideco Six-Inch Oil Bath Swivel

THE new Ideco six-inch Oil Bath Swivel, of the International Derrick & Equipment Company of Columbus, Ohio, embodies in its design all of the important features and strength factors necessary for extra heavy duty in deep well drilling service.

An especially designed main bearing with a safe load capacity of 180 tons carries the downward load. A body thrust bearing of ample size absorbs the thrust of the body when the load is suddenly released from the bail.

The bearing housing and cap form a large oil reservoir, providing constant lubrication to all bearings. A large fluid passage through the goose-neck and wash pipe reduces back pressure and increases pump efficiency. All stuffing boxes are externally packed and easily adjustable from the outside of the swivel.

The bail is heavily constructed with ample clearance between bail and goose-neck. Two bail stops hold the bail in position. The lower stop prevents the bail from falling on the hose while the upper stop holds the bail in position when connecting or disconnecting the hose.

Heavily constructed trunnions, cast integrally with the housing, carry the heavy loads with ease. Perfect alignment and equal distribution of the vertical load is obtained by means of a heavy-duty bearing under the main bearing support.

New Republic Welded Pipe

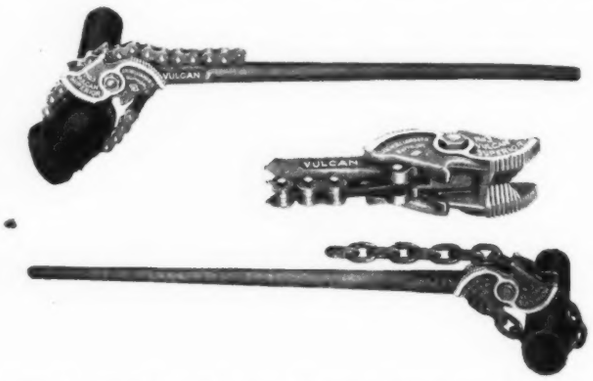
A NEW kind of welded pipe has been made available to pipe users with the placing in operation of Republic Steel Corporation's new plant at Youngstown, Ohio, devoted to the making of electric-weld pipe.

An experimental mill making only small sizes has been in production for almost a year, with the result that over 2000 miles of pipe were placed in service. According to the Republic concern, the demand created made necessary the building of a completely equipped new plant for making sizes from 4½ to 16 inches in diameter.

Williams New Pipe and Fittings Tongs

J. H. WILLIAMS & CO., Buffalo, N. Y., has just introduced its "Vulcan Superior" chain tongs for universal service on both pipe and fittings—two tools in one. Two tools as commonly used (one for pipe and one for fittings) are unnecessary.

The "V" recess in the jaws are said to assure quick and positive grip on fittings. "Vulcan Superior" can be used

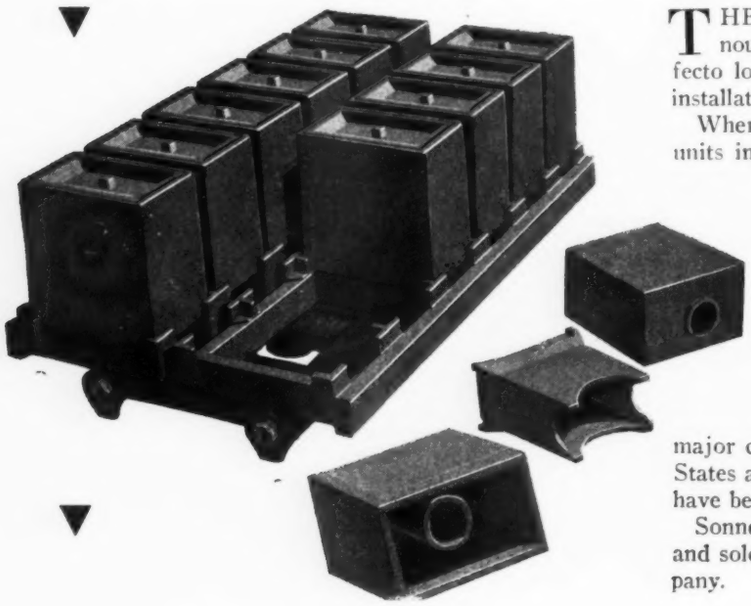


instantly on either pipe or fittings without stopping to alter the tool itself. There are no parts to lose.

It is claimed, by the company, that "Vulcan Superior" is the only chain tongs on the market with reversible pipe-and-fittings jaws. When the teeth first in use wear, simply turn the jaws end for end. This insures double life.

The chains, either flat or cable type, lock easily and positively. The tool is fully guaranteed and all parts are interchangeable. Literature will be supplied by J. H. Williams & Co., on request.

Improved Sonner Burner



THE Sonner Burner Company of Winfield, Kans., announces an improvement in the construction of its Perfecto low pressure gas burner, which reduces the labor of installation and simplifies the re-servicing of the burner.

Where formerly the burner was assembled with twelve units in one section, weighing 220 to 260 pounds, the new manifold has been so designed that the burners themselves are merely set on the manifold after pipe connections have been made. By this improved construction no part of the burner weighs more than 20 pounds. Although the 12 units are assembled in the same space formerly occupied in the old type section, one or more units may be removed and replaced at any time, without first shutting down and cooling off the boiler.

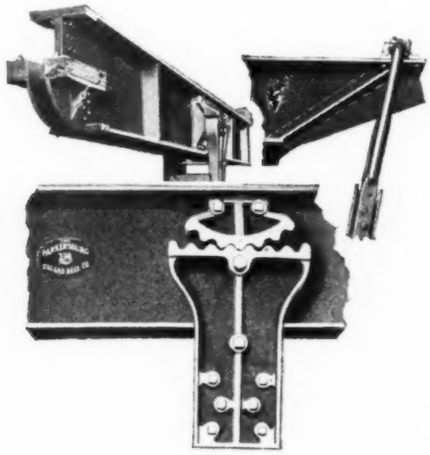
Perfecto burners have been tried and tested by major companies and contractors in all parts of the United States and in several foreign countries in the five years they have been on the market.

Sonner Burner Company products are now carried in stock and sold by the various stores of the Oil Well Supply Company.

New and Improved Items Introduced by Parkersburg

AMONG the several new and improved pieces of equipment recently introduced by the Parkersburg Rig & Reel Company are a new chain-driven rig front, counterbalance and improved reinforcement for walking beams.

The new rig front is a compact operating assembly mounted as the regulation band wheel shaft. It has all the



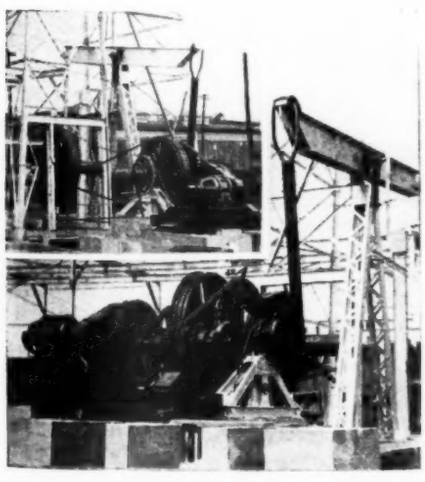
capacity and is said to incorporate in its assembly every feature of recent proven merit which assures economical and efficient handling of all phases of well operation.

Self-aligning roller bearings on the crankshaft and countershaft are features which increase the efficiency and lengthen the service life of the unit. Its simple, sturdy and accessible construction makes it easy to assemble or dismantle, thus adding the advantages of portability.

Bull wheels, calf wheels and sand reel are optional and the rig front may be installed with any standard size derrick.

This unit is furnished for use with electric motor, reverse clutch gas engine or steam engine drive.

A unique improvement in walking beams is Parkersburg's new practice of welding an angle reinforcement on the pitman end. A heavy steel angle is welded on both sides of the main section, materially strengthens the assembly and divides the load evenly between both flanges of the beam. Welding eliminates the need of drilling so that the beam retains its full strength, to which is added the stiffness of the angle in a direct line with the load.



Walking beams of this type are available equipped with Parkersburg IC type center trunnion saddle irons or ICR center rocker fittings, as they are interchangeable.

Parkersburg's all-steel band wheels are now made in halves to solve the problem of transporting large diameter wheels.

Convenience in the loading, hauling and shipping of wheels of great size, as well as avoiding trouble with road laws in certain states, is a vital factor, and the Parkersburg two-piece rim idea is sure to meet with universal favor.

The method of manufacturing wheels in this manner is to roll the rim in one piece and then to saw it in half by a method which assures its accurate shape and true running qualities.

As may be seen from the illustration, the rim splice is strengthened with cast steel angle bars riveted inside the rim. They fit the crown contour of the face and bolt together after the idea of a belt clamp. Two of the five bolts which hold the splice secure are drive bolts which extend

through extra thick bosses on the bars and act as dowel pins, keeping the rim joint in such perfect alignment that the splice can hardly be found except by close inspection of the face.

These Parkersburg two-piece rim band wheels known as type "P," are available in 10, 11, 12 and 14-foot diameters in 12, 14 and 16-inch width faces. Equipped with double or triple rolled groove tug rims, as desired. Shipments are made either assembled or knocked down.

New Type Oxygen and Acetylene Manifolds

IN order to furnish small users of oxygen and acetylene with an economical means of gas distribution, Oxweld Acetylene Company, 30 East 42nd St., New York, has introduced two small-capacity manifolds.

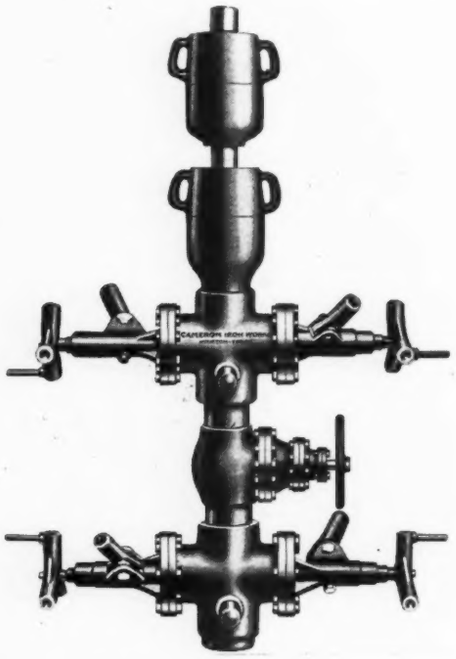
The six-cylinder oxygen manifold is of the wall type and has the duplex feature just as larger Oxweld manifolds have, so that three cylinders may be changed while the bank of three on the other side is maintaining the supply of oxygen.

The four-cylinder acetylene manifold is also of the wall type. Each cylinder lead has a valve in the header, so that each separate cylinder is independent of all others. This makes it possible to use either one, two, three or four cylinders at the same time. Each cylinder connection is fitted with the Prest-O-Lite flash arrester.

C.-I.-W. Equipment for Snubbing Against Pressure

CAMERON IRON WORKS, 711 Milby Street, Houston, Texas, has developed equipment for snubbing tubing under pressure. It is claimed that the method is simple, safe, easily used and easily set up.

The C.-I.-W. Tubing Control Heads are mounted, with a gate valve in between, onto the last string of casing into which the tubing is to be snubbed. Specially constructed snubbers are used to force the tubing into the well against pressure. Wire lines are run from ears in the traveling snubber through sheaves mounted to the derrick foundation and thence back to a pulley on the traveling block. This is a single continuous line thus equalizing the pull-



down force on both ears of the snubber and holding the tubing on a straight course.

These snubbers are fitted with inverted slips to allow the passage of couplings. A stout spring keeps the slips in their proper position in the snubber. When a coupling approaches the slips they push down and away from the pipe to allow the couplings to pass. This same type of coupling is used in both the stationary and traveling snubber, and at no time are both released from their grip on the tubing.

Details of the hook-up and means of operation may be obtained from the Cameron Iron Works.

New Oil Well Surveying Instrument

A NEW instrument for surveying oil well holes has been developed by the Accurate Oil Well Surveying Company, 113 North 21st street, Montebello, Calif.

This instrument gives a constant and uninterrupted reading from top to bottom of the well.

The owners claim it is unaffected by terrestrial magnetism, high temperatures or other influences. It is based fundamentally upon the factors of time and gravity and is extremely simple.

It is provision for free circulation at bottom, and is capable of rapid operation in case there is gas in the hole. It provides an immediate reading upon return from the hole and is open to observation both as to mechanism and method of operation.

New Neilan Valve for Modern Processes

NEILAN CO., LTD., Los Angeles, has introduced a new Neilan rotary stem, diaphragm-motor valve to meet the requirements of increased temperatures and pressures of the new processes. Friction is eliminated through the widespread application of ball bearings. Nirosta KA-2 stainless steel ball bearings, valve stem and linkage are used to prevent corrosion in the valve body where corrosion fluids are generally present.

The new Neilan motor valve is made in chrome-alloy cast steel for high temperatures and pressures. These valves fill an urgent need in modern refineries and industrial plants where high temperatures and pressures are encountered. This valve is made for use with instrument type temperature controllers, flow controllers and liquid level controllers.

New Type Universal Rotary Hose

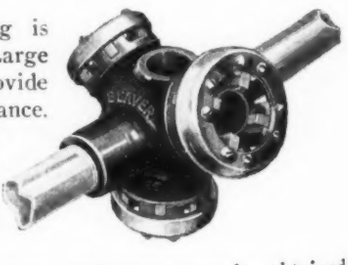
THE Elliott Manufacturing Company of Los Angeles is now manufacturing a new type universal joint constructed rotary hose. It consists of eleven simple universal joints connected together by ten pipe sections. These flanged universal joints are interchangeable. The joint itself is machined from solid bar S. A. E. 1035 steel, heat-treated throughout. The outer flange is a steel forging.

The straight-line construction of the joints offers the least resistance to the cutting action of the sand particles carried in the mud. No sharp bends or right angles are formed and no distortion or contraction of the fluid area takes place. In flexibility it offers the same as rubber hose. The safety factor is over 8,000 pounds per square inch.

When hung in the derrick a rigid steel clamp is provided for each pipe section through which a steel sand line is strung and anchored to the swivel and to a leg of the derrick.

New Beaver 3-Way Die Stocks

THE Borden Company, Warren, Ohio, is manufacturing new Beaver 3-way die stocks which are companion tools to the No. 3 Beaver Jr. ratchet—the dies and caps being interchangeable.



The die retaining ring is made of pressed steel. Large openings in the body provide easy oiling and chip clearance. The die segments are square in shape and electrically heat-treated. They are driven by the solid body of the tool.

Full particulars on this new equipment may be obtained from the company in Bulletin A-1.

1 to 2% by weight of

AQUAGEL

ADDED TO YOUR DRILLING MUD

not only costs you NOTHING but in addition will save you thousands of dollars . . . . . .

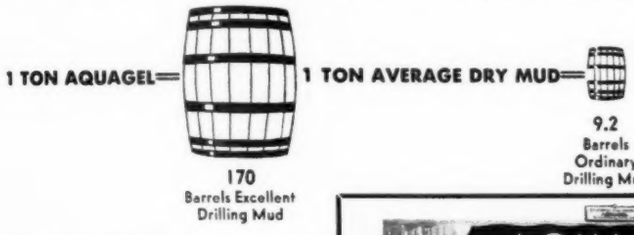
because:

AQUAGEL speeds drilling at least 20% in most fields by insuring rapid removal from the well of larger cuttings than usual . . . thus preventing loss of time ordinarily spent pulverizing cuttings after they have been disengaged from the formation by the bit. The saving in time pays for the small amount of AQUAGEL used . . . many times over.

AQUAGEL prevents caving and allows you to drill through caving or heaving shales without loss of time. Each day's time lost fighting cavings costs you at least $100 for labor . . . and each day's time lost completing a well means loss of a day on production. In a well ultimately completed, at 5,000 barrels with oil selling at $1.50 per barrel each day's delay costs you $7,500 . . . A few tons of AQUAGEL will make such a saving possible.

AQUAGEL prevents loss of circulation and gas-cutting, one or the other of which is responsible for 95% of the blowouts. Preventing a blowout may result in a saving of many thousands of dollars . . . Aquagel lubricates pump liners, pistons, drill pipe, casing and walls of the hole, preventing abrasion and lowering power costs. In many wells, the saving in pump parts alone has more than paid for all AQUAGEL used.

AQUAGEL prevents penetration of drilling mud or water into the producing sand when drilling in . . . Water penetrating the sand is responsible for partially mudding off the production of many wells when they are completed . . . The use of AQUAGEL insures maximum production upon completion.



One ton of AQUAGEL, mixed with water, will produce 170 barrels of excellent drilling mud. One ton of average Mid-Continent dry mud such as is used in drilling wells, will produce 9.2 barrels of ordinary drilling mud. Where it is necessary to buy mud, you can afford to pay, on volume basis alone, 18.4 times as much per ton for AQUAGEL as average Mid-Continent drilling mud.

Be sure to visit our Exhibit at the International Petroleum Exposition and Congress. Tulsa, October 4-11. Interesting and instructive.

Our new Drilling Mud Handbook is just off the press . . . It contains considerable valuable information for those interested in drilling . . . Whether you need AQUAGEL or not—we believe you will be interested in having a copy. Just fill in the coupon below and mail.

For your convenience . . . . . AQUAGEL, in 100-lb. sacks, is carried in stock by a large number of distributors in every oil field.

CALIFORNIA TALC COMPANY

837 JACKSON STREET
LOS ANGELES, . . . CALIFORNIA

DISTRIBUTORS

California
Oil Well Supply Co.
Rotary Materials Co.
Crail Bros.
Speed & Service Trucking Co.
Lang Transportation Co.

Kansas, Oklahoma, Texas, New Mexico
Bridgeport Machine Co.

Export
Oil Well Supply Co.

Texas Gulf Coast, Louisiana, Arkansas
Lucey Products Corp.
Nowery J. Smith Co.

OR AT YOUR FAVORITE SUPPLY STORE

MAIL THIS COUPON TODAY

Please send me, without obligation on my part, a copy of your latest bulletin describing AQUAGEL, the concentrated colloidal compound for drilling wells.

Name_____

Street_____

City_____

When writing CALIFORNIA TALC CO. *please mention The Petroleum Engineer*

Chicago Pneumatic Secures Big Order

THE Chicago Pneumatic Tool Company, 6 East 44th Street, New York City, has received an order for nineteen 265-horsepower "CP" gas engines for use on the Phillips Pipe Line. This pipe line will be one of the first constructed for the transportation of gasoline direct from the refinery to market points. It will carry gasoline from various locations in the Panhandle to Kansas City, St. Louis, etc. These engines will use commercial Butane, a fuel produced by the Phillips Petroleum Company.

Leland Moves Oklahoma City Office

THE Leland Equipment Company, manufacturers of truck equipment and road and construction equipment, has moved its Oklahoma City office to a new and larger location at 1637 West Main Street. The telephone number remains 7-1114.

New Attachment for the Oxweld W-17 Welding Blowpipe

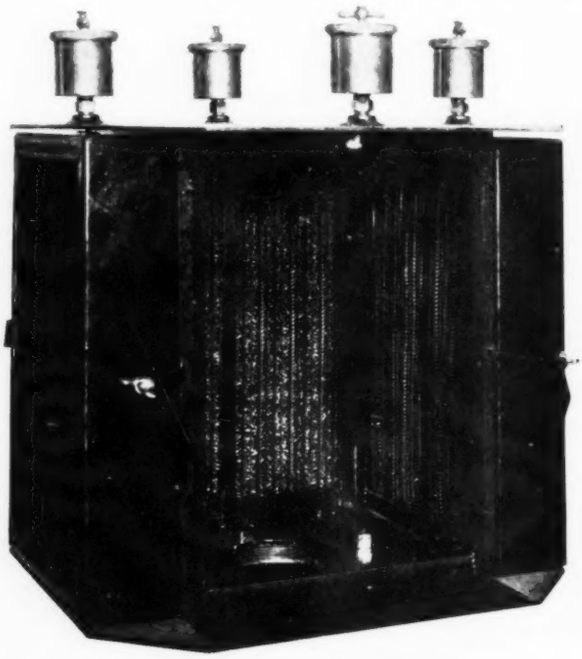
OXWELD ACETYLENE COMPANY, 30 East 42nd street, New York, has recently introduced new accessories for the Type W-17 welding blowpipe, introduced during the past winter, which now makes this blowpipe capable of doing almost any type of work which may be required of an oxy-acetylene blowpipe.

The Type CW-17 cutting attachment enables the blowpipe to do a reasonably wide range of cutting work. This cutting attachment differs radically from any such attachment which has previously been manufactured. A long handle is used for operating the cutting oxygen valve. When this handle is not in use, it can be pulled forward parallel to the tubes so that the whole attachment may be carried around in the operator's pocket. The attachment has the same style stem lock nut as the welding head for the Type W-17 blowpipe. The injector for the heating flames is contained in the attachment, just as the injectors are contained in the welding heads. At the rear of the attachment near the botom is an adjusing screw, so that the oxygen for the heating flames may be regulated by the operator's thumb and forefinger while the blowpipe is in operation. The attachment is joined to the blowpipe handle in exactly the same manner as a welding head, that is, the lock nut can be tightened by hand and no wrench is necessary to join the attachment to the handle. The attachment is supplied with two cutting nozzles.

New V-C Wick-Lube Air Filter

THE Vinson-Canter Company, Tulsa, Okla., has announced a new V-C Wick-Lube Air Filter. This is a unit type filter made up of either one, two, three or four units, as may be required by the quantity of air to be filtered.

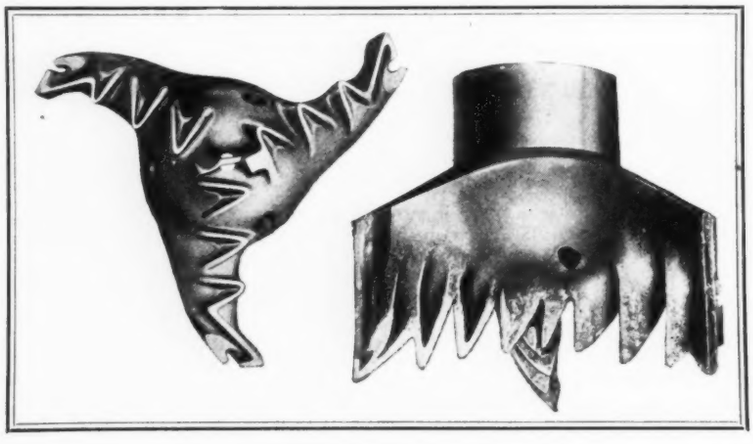
It is designed primarily for removing sand and dirt from the air to the suction of internal combustion engines and



compressors. The filter media is of corrosive resisting materials. A new and unique method is used to keep the filter units covered with adhesive oil, which removes the sand from the air.

This oil is added to each unit very slowly by means of wick-lubricators mounted directly above the unit. The oil is then spread thoroughly through the unit by means of wicks which are inclosed inside the frames. Oil is fed continuously over the filter units preventing them from drying during operation.

New Rake Tooth Bit



THE Baash-Ross Tool Company of Los Angeles, Calif., has recently announced the addition of the Baash-Ross rake tooth bit to its line of equipment.

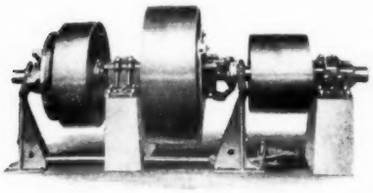
The most important feature of the new bit, according to the maker, is that it is self-sharpening. This is accomplished by the patented hollow-back teeth which automatically sharpen as they wear. This permits a constant cutting edge with a cutting action instead of scraping.

As a result of maintaining a sharp cutting edge, it is claimed that the Baash-Ross rake tooth bit requires less power, minimized strain on the drill pipe and drills a straight hole. Each tooth is so placed that it cuts its own path and does not follow the path of any of the other teeth.

Reid Reversible Countershaft

A NEW Reid reversible countershaft has been built for installation where a belted reverse countershaft is preferred to the direct-connected gear-driven reverse clutch by the Joseph Reid Gas Engine Company, Oil City, Pa.

A stub shaft on the engine is supported by a pedestal bearing and carries two pulleys which transmit the forward and reverse motion to the five-inch countershaft by means of a straight and a cross belt. The countershaft straight and cross-belt pulleys idle on the shaft until set in motion by two Reid 24-inch band type clutches which are keyed to the shaft. The countershaft take-off pulley is keyed solidly to the shaft. A single lever controls the mechanism and engages either the forward straight or the reverse cross-belt pulley, automatically disengaging the pulley which is being relieved of service.



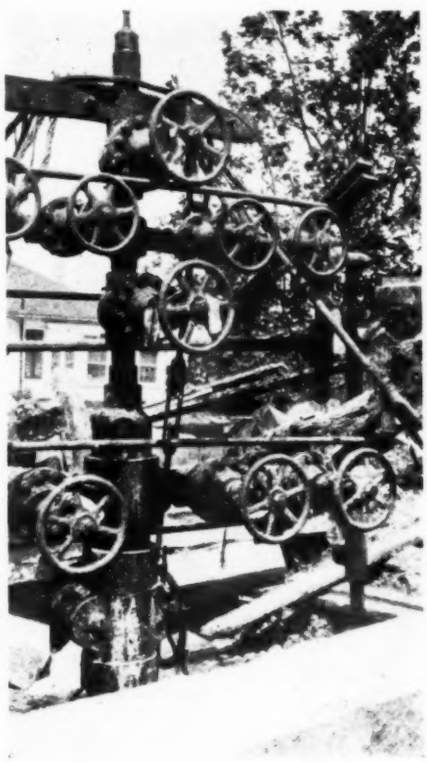
The cross-belt pulleys are overhung on the countershaft and stub shaft, which causes less bending movement and facilitates the removal of the reverse belt.

A choice of Timken or bronze-bushed bearings is available throughout the rig.

McEvoy Tubing Retractor

THE J. H. McEvoy & Company, 600 Milby Street, Houston, Texas, has placed on the market a new tubing retractor, which makes possible the closing of the master gate valve, while the tubing is in the well.

The tubing is anchored to a by-pass tubing hanger which rests on the top end of a special nipple between the master gate valve and casing coupling.



Inside the body there is a vertically moveable telescope which works on a rack and gear assembly and is controlled by a hand wheel, worm and gear. The telescope is seated in by-pass tubing hanger when the well is flowing. However, at any sign of trouble, such as sand cuttings, leaky manifold, fire, or any reasons for desiring to shut in the well, a few turns of the retractor hand wheel which revolves with noticeable ease, under all pressures, and the master gate is free to be closed.

Link-Belt Adopts Drop-Forged Sidebars

ANNOUNCEMENT of the adoption of drop-forged sidebars for the SS-124 Hyper rotary chains has just been received from the works of Link-Belt Company, Indianapolis, Ind.

In the design of this new drop-forged sidebar SS-124 Hyper chain, Link-Belt engineers had foremost in mind to offer a rotary chain that would be convenient and practical for the man in the field to handle, and at the same time to supply a rotary chain strong and reliable in all its parts and makeup.

The drop-forged steel sidebars, of a new exclusive Link-Belt design, are produced from nickel chromium alloy steel drop forgings, carefully normalized after forging, and heat-treated. The pin and bushing holes are finished to precision limits by the new "Sizeite" process recently developed for oil field rotary chains.

The design is of the offset sidebar type, and the offset in the link is strongly reinforced by a rib of heavy section which prevents distortion of the pitch of the chain under extreme loads.

New Allis-Chalmers Oil Well Unit

THE Allis-Chalmers Manufacturing Company has a new oil well unit, known as No. 11. It has the following features: Seven-inch main shaft, interchangeable bearings, universal rails for any motor—600 to 1,200 R. P. M.—post brake, shock-absorbing texrope drive to give any number of pumping strokes, crank balance or flywheel effect optional, automatic lubrication, and choice of housing arrangements, new explosion-proof motors with open motor mounting dimensions in most ratings and approved by underwriters.

L-M Utilities Insulate Cyril Plant

THE Anderson-Pritchard Oil Corporation's plant at Cyril, Oklahoma, has been equipped by the Petroleum Engineering, Inc., of Tulsa, and insulation was done by the L-M Utilities Company of Tulsa.

Material used was 1½-inch of mineral wood blanket, applied to all surfaces over which was placed one-half inch of Eagle "66" insulation cement, all of which is manufactured by Eagle Picher Lead Company at Joplin, Mo., and distributed in Oklahoma and Kansas by L-M Utilities Company.

After insulating as above the entire surface is covered with canvas and painted with guaranteed waterproof paint, then sprayed with aluminum paint.

RUNNING TOUR With Men In The Industry

F. L. Tyler

Fred L. Tyler, Tulsa (Okla.) manager of the Chicago Pneumatic Tool Company, with offices in the Philcade Building, is a newcomer to the trade in the Mid-Continent territory. He was formerly located in Mexico City.

ŏ ŏ ŏ

Carl King, superintendent of Wickwire Spencer Steel Company's mill at Palmer, Mass., where Wickwire Spencer wire rope is made, is making an extended visit through the Mid-Continent oil fields. He will remain in this district until after the oil show.

ŏ ŏ ŏ

C. Allen Fulmer has joined the Stanwood Corporation of Cincinnati, Ohio, as Mid-Continent representative. He is located at 327 Exchange National Bank Building, Tulsa.

ŏ ŏ ŏ

O. G. Ross has become field superintendent for the Olean Petroleum Corporation of Bristow, Okla.

ŏ ŏ ŏ

J. O. Buchta of Bartlesville Supply Co., St. Louis, Mo., spent several days recently in Tulsa and the Oklahoma fields.

ŏ ŏ ŏ

Fred E. Mallonee has been placed in charge of the Kansas producing division of the Magnolia Petroleum Company, with headquarters at Wichita. He is a former White Eagle Oil and Refining Company official.

ŏ ŏ ŏ

C. S. Sanders, electrical engineer of the Midwest Refining Company at Casper, Wyo., has been transferred to Carlsbad, N. M., and will direct work in the Hobbs field.

ŏ ŏ ŏ

C. D. Lowry, Jr.

Dr. C. D. Lowry, Jr., research chemist with the Universal Oil Products Company, Chicago, has been elected secretary of the Petroleum Division of the American Chemical Society.

ŏ ŏ ŏ

Grover Simpson, of Loffland Bros. Drilling Co., has been in the Hobbs field for some time.

H. L. Montgomery, manager of the natural gas division of the Cities Service Gas Co., is recovering from an operation for appendicitis at his home in Bartlesville.

ŏ ŏ ŏ

Carl B. King, drilling contractor of Tulsa, has been a recent visitor to the Hobbs field.

ŏ ŏ ŏ

A. W. Walker, with the Indian Territory Illuminating Oil Company, Seminole district, has been transferred to the Oklahoma City district petroleum engineers department.

H. L. Montgomery

ŏ ŏ ŏ

C. A. Fulmer

R. H. Crowe, in charge of operations in Texas and New Mexico for the Haynes Drilling Company, visited the Hobbs field last month.

ŏ ŏ ŏ

Walter Mayden, assistant gas engineer with Indian Territory Illuminating Oil Company at Bartlesville, Okla., is the proud father of a baby girl.

ŏ ŏ ŏ

Husky Reynolds, with Reynolds Drilling Company, Oklahoma City, spent his vacation last month in the East.

ŏ ŏ ŏ

W. B. Englebrecht recently resigned from the engineers department with the Indian Territory Illuminating Oil Company at Oklahoma City to accept a position with the Phillips Petroleum Company as refinery engineer.

ŏ ŏ ŏ

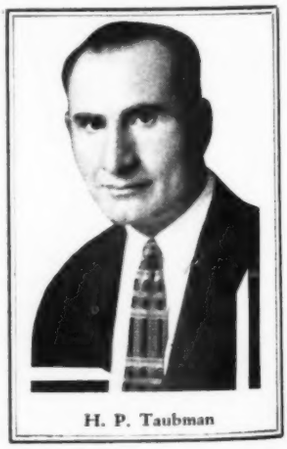
A. H. ("Cotton") Holder, in charge of operations in the Seminole district for Loffland Bros. Drilling Company, is now in the Hobbs area.

ŏ ŏ ŏ

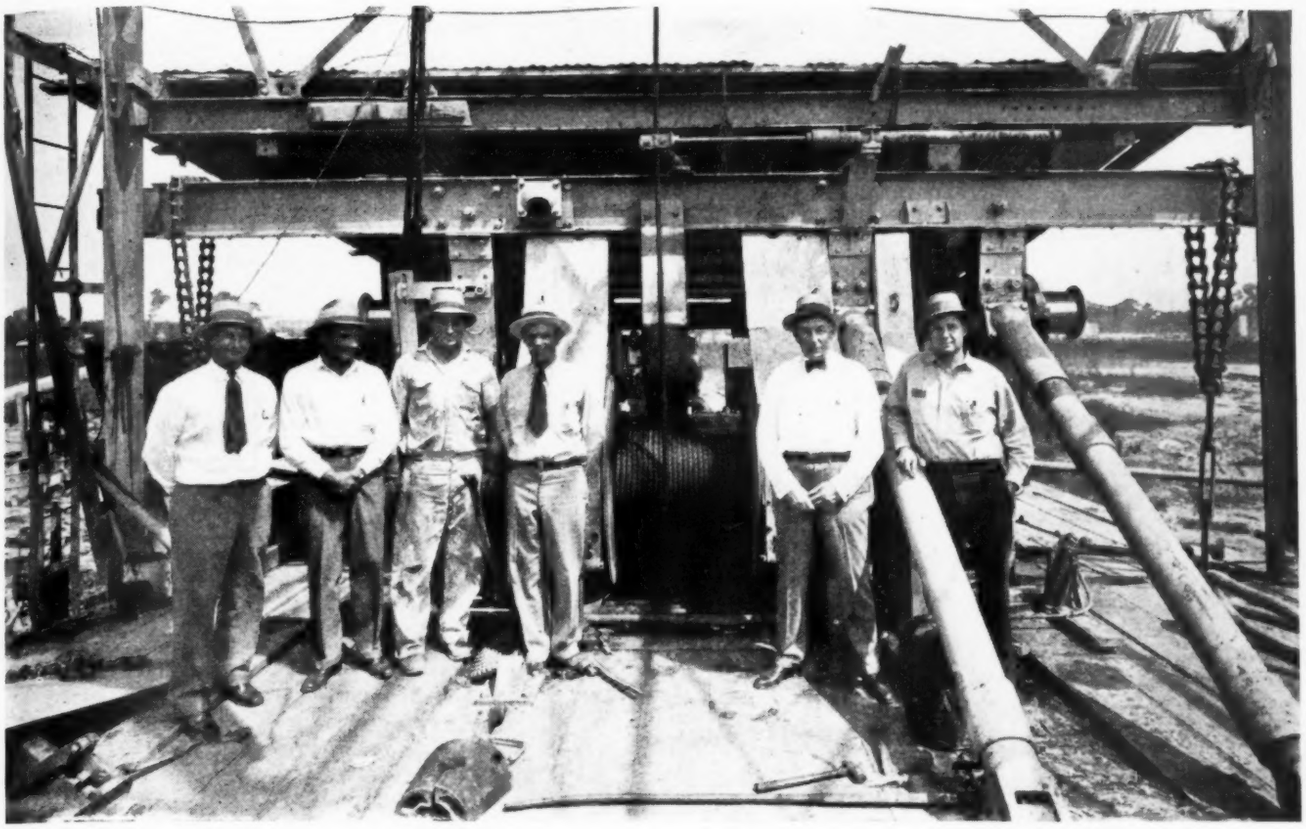
Herman P. Taubman, head of the Taubman Supply Corporation, Tulsa, has returned from a trip to Massachusetts.

ŏ ŏ ŏ

C. M. Ridgeway, superintendent of the Old Dutch Refining Company, Muskegon, Mich., was married on September 27th to Miss Elizabeth Fredericka von Tacky at Titusville, Pa.



H. P. Taubman



This Union Line Stood the Test at Oklahoma City

When Campbell and Parker drilled the Wirt Franklin Wright No. 2 in the Oklahoma City Field to 6552 feet, the UNION ROTARY LINE - - as usual - - stood the test. The above photo shows tearing down and getting ready to bail. The men, left to right, are: Jas. A. Undercofler, Union Wire Rope Corp.; Dick Barnett, tool pusher; Sandy Cummings, driller; and G. C. Parker, J. A. Campbell and Glenn A. Campbell, of Campbell and Parker Drilling Company.

UNION oil country wire lines stand up because they are designed by men who know the work they have to do, and are manufactured entirely within our own modern plant under conditions that can assure unfailing uniformity.

UNION WIRE ROPE CORPORATION
3 North Madison Ave., Tulsa, Oklahoma
Oil Country Sales and Export Offices: 338 Kennedy Bldg., Tulsa
Branch Office and Warehouse: Portland, Ore.
Factory: 21st and Manchester, Kansas City, Mo.

JARECKI MANUFACTURING COMPANY
Mid-Continent and Eastern Oil Field Distributors - - Stocks at All Stores

UNION WIRE ROPE CORP.
TRADE MARK

UNION WIRE LINES

When writing Union Wire Rope Corp. *please mention The Petroleum Engineer*

R. P. Tarbell

Ray P. Tarbell has recently become a member of the firm of Robert E. Kinkead, Inc., consulting welding engineers, Cleveland, Ohio. He was formerly Cleveland district sales manager of the Lincoln Electric Company. Mr. Tarbell is vice-president and secretary of Robert E. Kinkead, Inc.

ŏ ŏ ŏ

G. M. Kirkpatrick of the traffic department, Blaw-Knox Company, Pittsburgh, Pa., left Pittsburgh September 3 for a trip to the Mid-Continent. He visited Shreveport, Houston, Tulsa and other points, and returned to Pittsburgh September 20.

ŏ ŏ ŏ

L. D. Todd, recently farm boss in the Seminole district for I. T. I. O., has been transferred to Oklahoma City to succeed Howard Walton, resigned. L. L. Cunningham has been appointed successor to Mr. Todd. Cunningham's former territory has been consolidated with H. L. Bufkin's district.

ŏ ŏ ŏ

Julian L. Foster, chief engineer of the Lone Star Gas Company, accompanied by R. L. Vandercook, pipe line superintendent, and Wilder Keenan, consulting engineer on bridges, has made an inspection tour of the Missouri Valley pipe line. Special attention was devoted to bridges, river crossings and sites for compressor stations.

ŏ ŏ ŏ

C. S. Powers is district sales manager for the new offices of The Republic Steel Corporation which have been opened at 404 and 405 Thompson Building, Tulsa.

ŏ ŏ ŏ

Martin Van Stappen has been appointed sales manager of the industrial blowers and turbine department of the Coppus Engineering Corporation, with general offices and plant at Worcester, Mass. Ernest Kundig has been appointed sales manager of the house heating blower department, as well as export manager of the company.

ŏ ŏ ŏ

J. E. Hodgins, vice-president, Jenkins Bros., Boston, Mass., visited in Tulsa last week, calling on the local trade of his company.

ŏ ŏ ŏ

M. E. Montrose is in charge of the new offices opened at Shreveport by the General Electric Company to serve that territory.

J. A. O'Neal

ŏ ŏ ŏ

James A. O'Neal is now superintendent of the Bossier refinery of Louisiana Oil Refining Corporation. He came to the refinery as boilermaker foreman and has made steady progress toward his new position.

ŏ ŏ ŏ

Don S. Bowers of the W. C. Norris Manufacturing Co., Tulsa, visited the trade in California during September.

The Foster Wheeler Corporation has opened offices in Tulsa. C. C. Steward is in charge. He comes from California to Tulsa. This company has for several years manufactured equipment and apparatus for power stations and for the complete refining of crude oil. The new Tulsa office is primarily a branch of the natural gasoline department, which has been a part of the company for the past year and a half.

C. C. Steward

ŏ ŏ ŏ

C. L. Henry, formerly Gulf Coast representative for Lee C. Moore, has gone to Pittsburgh, Pa., to become chief engineer of the company. H. M. Lassiter, formerly in West Texas territory, will take charge of the Gulf Coast district.

ŏ ŏ ŏ

John C. Ford has resigned as general superintendent of the producing department of the Transcontinental Oil Company, now a subsidiary of the Mid-Kansas Oil & Gas Co.

ŏ ŏ ŏ

R. W. Featherstone, formerly of the stores department of the Lone Star Gas Company, has been transferred to the Missouri Valley Pipe Line Company at Omaha, Neb., to be associated with C. Frank Martin, purchasing agent, formerly of the Lone Star Gas Company. George Purvis has succeeded Mr. Featherstone in the Lone Star company.

ŏ ŏ ŏ

A. S. Matthews has been elected vice-president of the Pennzoil Company, Oil City, Pa. He will be in charge of lubricating oil sales. He was vice-president and general manager for a number of years of the New York subsidiary of the Pennzoil Company and more recently manager of the eastern division, with headquarters in New York City.

ŏ ŏ ŏ

Charles Woods, superintendent of the field department of the Union Oil Company in its Valley division, with headquarters at Maricopa, Calif., has been transferred to the head office in Los Angeles, from which point he will cover all field operations of the company, looking after the employe welfare.

ŏ ŏ ŏ

J. J. Zorichak recently succeeded Fred E. Wood as petroleum engineer for the Midwest Refining Company in Casper, Wyo. Mr. Wood was transferred to the Chicago office of the Standard Oil Company of Indiana. Mr. Zorichak has been assistant to Mr. Wood since April, 1926.

ŏ ŏ ŏ

L. G. Marsh, sales engineer, Taylor Instrument Companies, is now located in Tulsa. He formerly made Rochester, N. Y., his headquarters.

L. G. Marsh

ŏ ŏ ŏ

Arden Ash, refrigeration engineer with the Carbondale Machine Company, is at present doing some work at the Mid-Continent refinery plant at Tulsa.

FLUID PACKED PUMP
FPP

WHO'S WHO IN THE OPERATING FIELD?

Our Sales Sheets Readily Reveal It

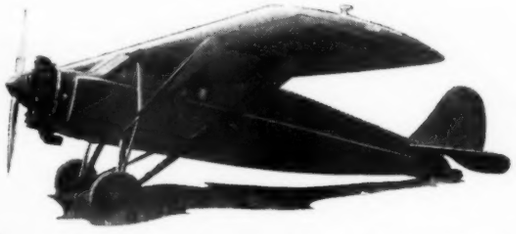
A man is known by the company he keeps »» a mechanic by the tools he uses and a business by the type and quality of its customers. We sell currently a majority of the leading operating companies in the Mid-Continent territory »» the term "Fluid Packed" serving as a merit badge of good judgment in their selection of material.

We represent two outstanding lines: the Fluid Packed Pump Company's production equipment and the Shaffer Tool Works' original material for meeting pressure conditions in both development and production operations.

SERVICE POINTS

OKLAHOMA: Tulsa, Drumright, Seminole. KANSAS: Winfield.
ARKANSAS: Smackover. LOUISIANA: Shreveport.
FACTORY: Los Nietos, California

YOUR NEIGHBOR KNOWS US!



FLUID PACKED PUMP COMPANY
FPP *Mid-Continent* FPP

ROBERT N. ATMORE CO., Tulsa, Okla.

When writing FLUID PACKED PUMP COMPANY OR ROBT. N. ATMORE COMPANY *please mention The Petroleum Engineer*

Edited by **BARNEY HORRIGAN**

There's no telling how long Methuselah might have lived if he had had his appendix, teeth and tonsils out, used the right brand of tooth paste and smoked coughless cigarettes.

ꝺ ꝺ ꝺ ꝺ

Cop: "Madam, didn't you see me hold up my hand?"
Woman at the wheel: "I did not."
Cop: "Didn't you hear me blow my whistle?"
Woman at the wheel: "I did not."
Cop: "Well, I guess I might as well go home. I don't seem to be doing much good here."

ꝺ ꝺ ꝺ ꝺ

"How old are you?" inquired the visitor of his host's little son.
"That is a difficult question," answered the young man, removing his spectacles and wiping them reflectively. "The latest personal survey available shows my psychological age to be 12, my moral age 4, my anatomical age 7, my physiological age 6. I suppose, however, that you refer to my chronological age, which is 8. That is so old-fashioned that I seldom think of it any more."—*The Exchange Spark.*

ꝺ ꝺ ꝺ ꝺ

"This pen leaks," said the convict, as the rain came in through the roof.

ꝺ ꝺ ꝺ ꝺ

Nervous Patient: "Will the anesthetic make me sick?"
Doctor: "No, I think not."
Patient: "How long will it be before I know anything?"
Doctor: "Aren't you expecting too much of an anesthetic?"

ꝺ ꝺ ꝺ ꝺ

Mistress: "Can you serve company?"
New Maid: "Yes, either way."
Mistress: "Either way?"
New Maid: "Yes, ma'am; so's they'll come again and so's they won't."

ꝺ ꝺ ꝺ ꝺ

Free and Baptized

"What is your religion?" the recruit was asked.
Promptly and smartly, came the answer, "Militia, sir."
"No, no, I said, 'religion.'"
"Oh, 'religion,' sir. I beg your pardon, I'm a plumber."

Helen: "I don't see why he dates her—she's a terrible dancer."
Mary: "No, she can't dance, but she sure can intermission."—*Blue and Gray.*

ꝺ ꝺ ꝺ ꝺ

Mother: "Now, Johnnie, I know thousands of little boys and girls who would be glad to eat that spinach."
Johnnie: "Name three of them!"

ꝺ ꝺ ꝺ ꝺ

Perfect Hostess

A deaf old lady went to live near one of the naval ports. Shortly afterwards a battleship fired a salute of 10 guns. The old lady, who lived alone, got out of her chair, smoothed down her dress, patted her hair, and said sweetly, "Come in."—*Tit-Bits.*

ꝺ ꝺ ꝺ ꝺ

Naturally

Servant: "The doctor's here, sir."
Absent-minded Professor: "Tell him I can't see him, I'm sick."

ꝺ ꝺ ꝺ ꝺ

Sure, Why Not?

"Why are the chickens making such a noise, mamma?"
"They want their breakfast."
"Well, if they're so hungry, why don't they lay themselves an egg?"

ꝺ ꝺ ꝺ ꝺ

Taking No Chances

Mother: "Now, Willie, I want you to get acquainted with the new nurse. Go in and kiss her nicely."
Willie: "Yes, and get my face slapped like papa did?"

ꝺ ꝺ ꝺ ꝺ

Grocer: "Don't you find that a baby brightens up a household wonderfully?"
Woman Customer: "Yes, we have the electric lights going most of the time now."

ꝺ ꝺ ꝺ ꝺ

Had Her Suspicions

Timid Wife (to husband who has fallen asleep at the wheel): "I don't mean to dictate to you, George, but isn't that billboard coming at us awfully fast?"

Curious: "Why do they call sail boats she?"
Cautious: "Because they make a better showing in the wind."

ꝺ ꝺ ꝺ ꝺ

"Am dis de place where dey send flowahs by wire?" asked a negro lady at the telegraph office.
"Yes'm," replied the clerk.
"Well, here am a potted geranium. Send it down to mah son in Richmond, V'ginia."

ꝺ ꝺ ꝺ ꝺ

Why Should She?

He (soulfully): "Do you think a married woman should work for a living?"
She: "Of course. I don't see why she should go hungry just because she's got a husband."

ꝺ ꝺ ꝺ ꝺ

He: "Did you ever hear the story about the traveling salesman?"
She: "I'll say so. I am the farmer's daughter."

ꝺ ꝺ ꝺ ꝺ

"What is this thing, dear?"
"Only a pawn ticket."
"Why don't you get two so we can both go."

ꝺ ꝺ ꝺ ꝺ

He: "Darling, do you think you could live on twenty-five dollars a week?"
She: "Yes, but no longer."—*Florida Times-Union.*

ꝺ ꝺ ꝺ ꝺ

After the Accident

Motorist: "Are you hurt, my boy?"
Butcher Boy (excitedly): "No, but I can't find my liver."

ꝺ ꝺ ꝺ ꝺ

"Did that young man kiss you last night?"
"Mother, do you suppose he came all the way up here just to hear me sing?"

ꝺ ꝺ ꝺ ꝺ

Correct Definition

Tad: "Pa, what's a matrimonial bureau?"
Dad: "It's a bureau, son, with six drawers packed full of women's fixings and one man's necktie."

Pictorial Petroleum

Monthly Rotogravure Feature of The Petroleum Engineer

October 1930

A North Texas Refinery At Sunset

Operating Men in the Hobbs N. Mexico Field

Harry Bass of Champlin & Bass, drilling contractors.

For use of the pictures of individuals on this page we are indebted to G. R. Elliott, advertising manager of Bridgeport Machine Co., Wichita, Kan.

O. T. McMillan of Smith, McMillan & McDaniels, drilling contractors.

John Schub, drilling superintendent for Schroeder Drilling Co.

Robert Christie, engineer for Amerada Petroleum Corp.

Leo Manning, field superintendent for Geo. F. Getty.

Si Young, with Amerada Petroleum Corp.

W. N. Vickers, sales representative for Bridgeport Machine Co.

Continental Oil Co.'s State Land Lease in Hobbs field.

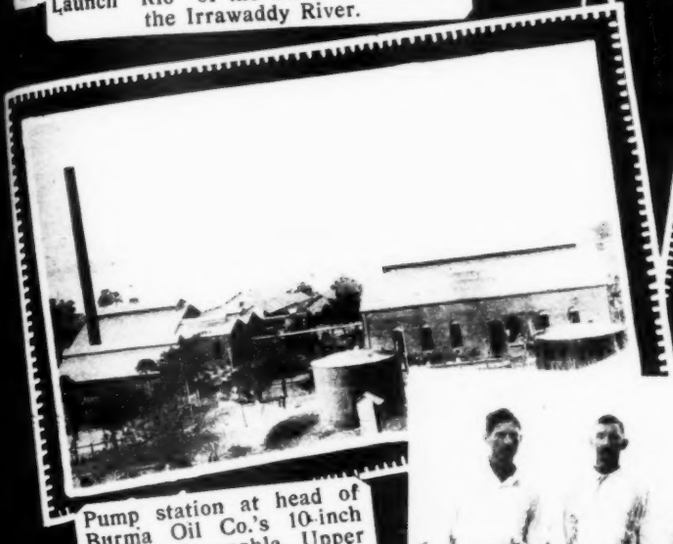
BURMA SCENES

DATED 1911-'13

A Buddhist shrine in Burma.

Launch "Rio" of the Burma Oil Co. on the Irrawaddy River.

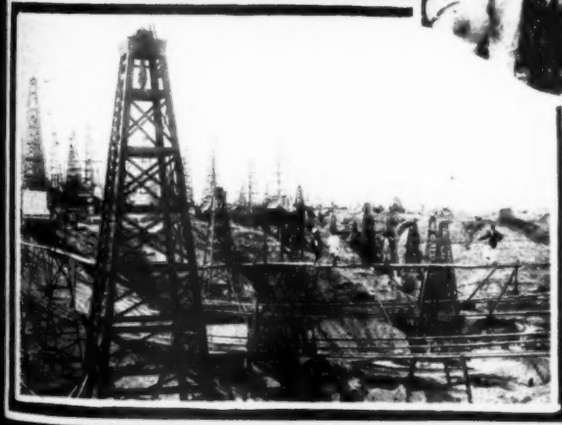
Typical driller's bungalow, Upper Burma fields.



Pump station at head of Burma Oil Co.'s 10-inch line at Nyaunghla, Upper Burma.

Tank farm at Nyaunghla.

Burma Oil Co. field men at Chauk, Upper Burma. Left to right--Jim Stroup, driller; "Sailor Bill" Rustymeyer, tool pusher; John A. Black, gas engine mechanic; Frank Rogers, blacksmith.



Scene in the Khodaung field.

A view of the Yenanyoung field.

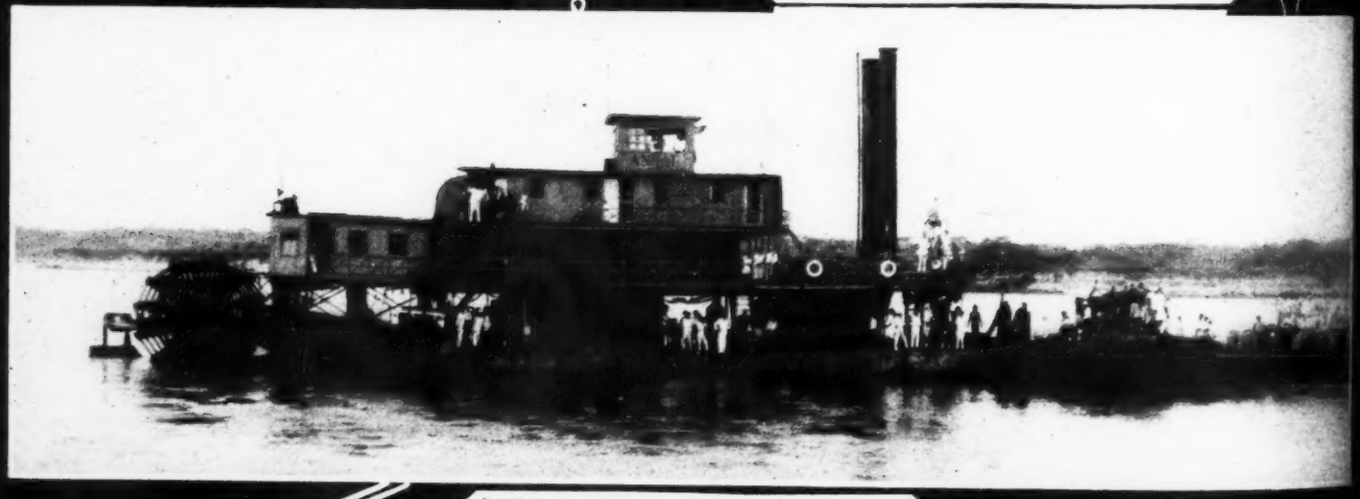
For the excellent photographs, taken in Colombia, which appear on this and the next page thankful acknowledgement in made to The Lamp.

Laying a "loop" in the jungle with native labor.

An Andian National Corporation, Ltd., line being laid near Puerto Mosquito station.

The Andian's all-metal Hamilton seaplane ready to take off on a trip into the interior.

Chingale pump station of Andian National Corporation, Ltd. Note the immaculate layout.



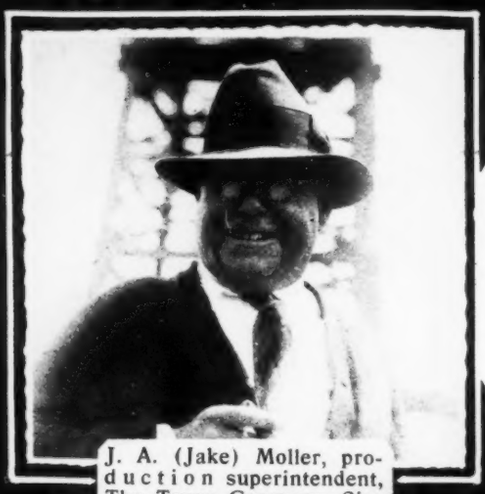
Andian steamer on the Magdalena River.

Street scene in Cartagena, with Andian National Corporation's office appearing in the background.

Pipelining in Colombia also presents its difficulties. Photograph shows ditching machine trapped by rapidly rising water.

Picturesque setting of Andian employees' quarters, Mamonal Terminal.

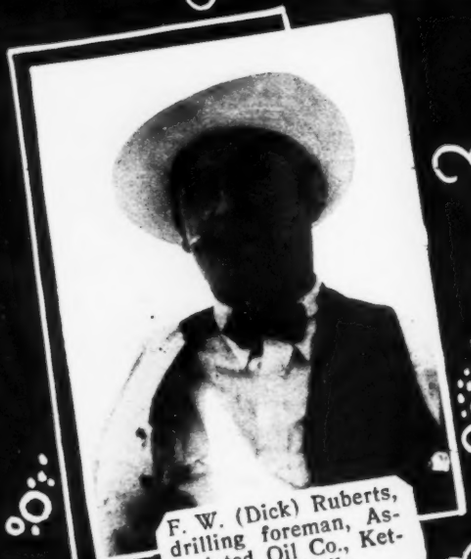
Operating Men in California Fields



J. A. (Jake) Moller, production superintendent, The Texas Company, Signal Hill.

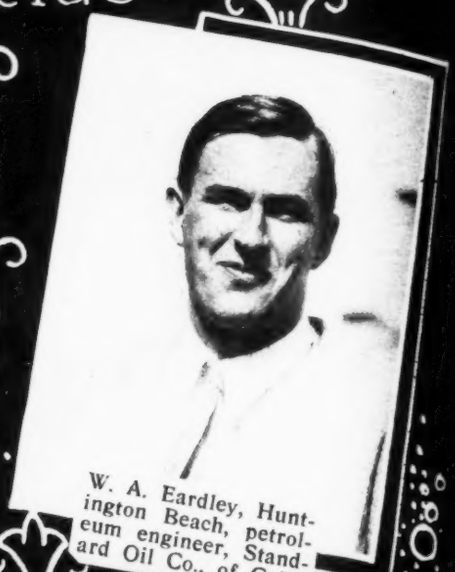
C. L. Giboney, production superintendent, Associated Oil Co., Kettleman Hills.

Bruce H. Lockard, engineer, The Texas Company, Long Beach.



F. W. (Dick) Ruberts, drilling foreman, Associated Oil Co., Kettleman Hills.

Wendell M. Jones. Petroleum Equipment Co., Los Angeles.



W. A. Eardley, Huntington Beach, petroleum engineer, Standard Oil Co., of Calif.

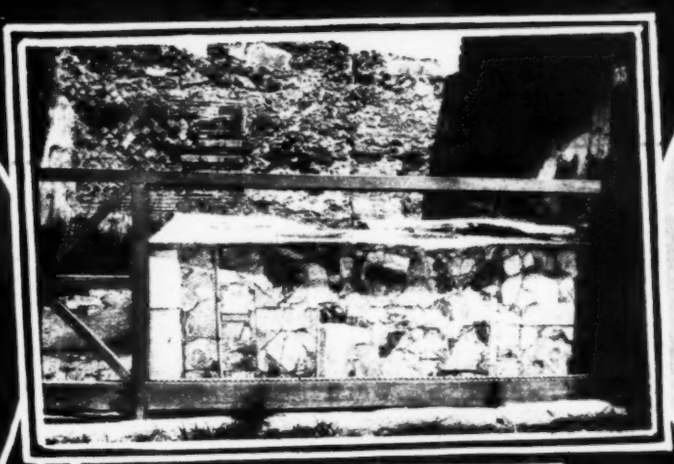
Rudolph Hartsman, district superintendent, Union Oil Co. of Calif., Dominguez field.

R. L. (Bob) Jackson, production foreman, The Texas Co., Santa Paula.

E. J. (Eddie) Hannon, farm boss, The Texas Company, Signal Hill.

George L. Klingaman, petroleum engineer, Standard Oil Co. of Calif., Huntington Beach.

W. H. O'Conner, general purchasing agent for Continental Oil Co., Ponca City, Okla.



It took M. J. Flanagan of Gaso Pump & Burner Co. to find this relic of ancient Pompeii. It's a bar, 2,600 years old.

Harry Moreland, vice president and general manager of Great Lakes Pipe Line Co., Ponca City, Okla.

R. S. Clark, store manager, Continental Supply Co., Winfield, Kan. This picture was taken while Mr. Clark was vacationing at Glenwood, Minn.

Attractive as a private home, this is the Houston, Texas, office of South Chester Tube Co.

Millard Land, air lift superintendent for Vacuum Oil Co. in a joyous mood. Mr. Land was here running test on an Ingersoll - Rand Maxiflow device.

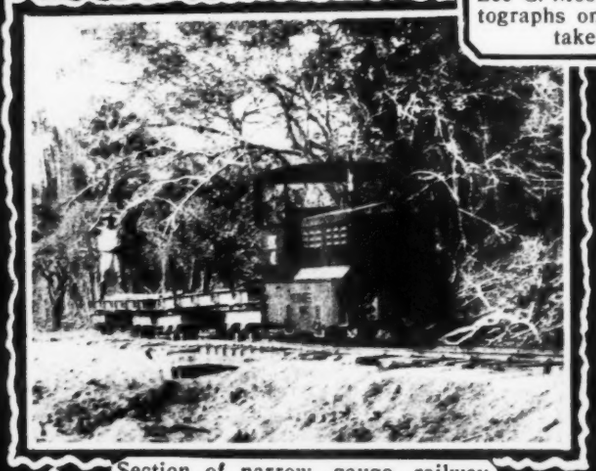
Olson Drilling Co.'s Buhl air sedan just before a take-off for the field. Left to right are Frank Bishop, toolpusher; B. F. Kelley, Mid-Continent representative for Titusville Iron Works Co.; T. B. Wirth of the Tulsa, Okla., office of Struthers Wells-Titusville Corp.; A. O. Olson; R. D. Robey, engineer, and R. C. Reeves, pilot, the three latter with Olson Drilling Co.

The discovery well of Lake Maracaibo field. It is property of Venezuela Oil Concessions Co. and when brought in, flowed 1,000,000 barrels of oil in 10 days.

Venezuelano out for a joy ride.

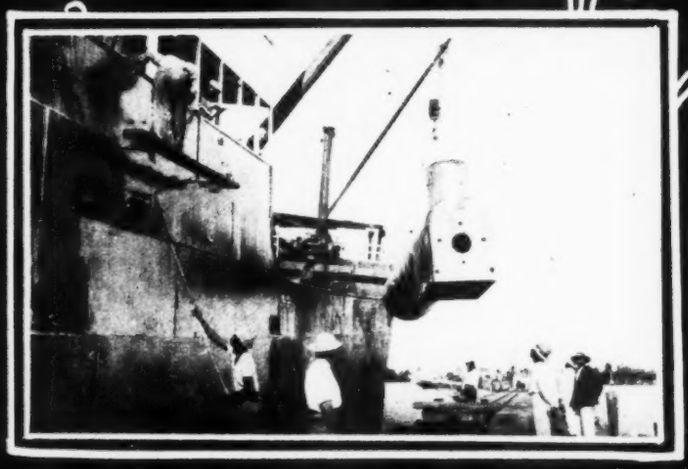
Memorable burning of the La Rosa field in 1924.

We are grateful to H. J. Woolslayer of Lee C. Moore & Co. for use of the photographs on this page. All views were taken in South America.

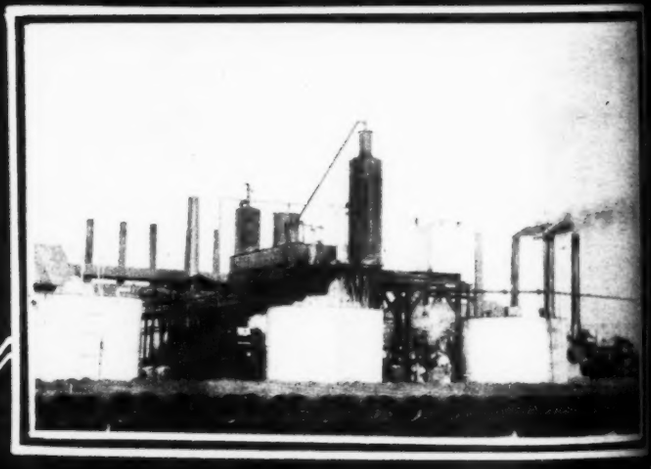


Section of narrow gauge railway built to carry supplies to various Lago Petroleum Corp. camps.

Tropical Oil Company's clubhouse at Barenca Barmeja.



Unloading a boiler at the Lago pier.



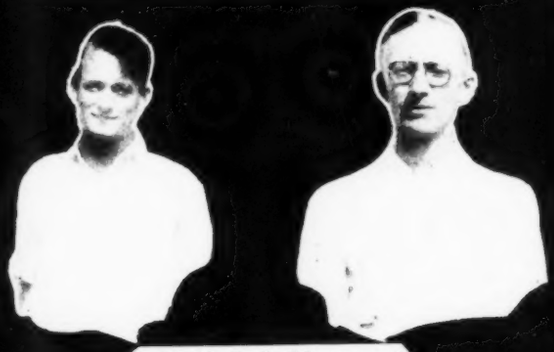
Lago's refinery at La Salina.

Standard Oil Co. of Indiana's Glenrock, Wyo., refinery.

Turner Valley, Canada, gas plant of Royalite Oils, Ltd. This plant treats gas for the city of Calgary, reducing the sulphur.

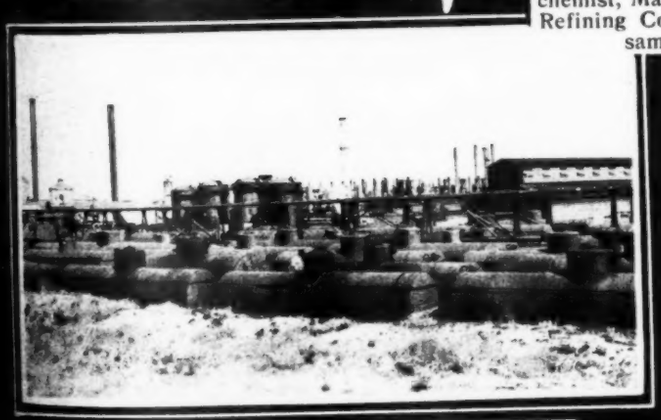
Regal refinery personnel, Calgary, Alberta, Canada. Left to right — R. Lindblom, accountant; M. T. Stevens, superintendent; M. J. Livingston, chemist; C. A. Parlee, foreman; G. Geairgescu, chief chemist; F. J. Huff, general manager.

Harry C. Sayre, State Board of Equalization, Helena, Mont. Mr. Sayre visits all refineries and gasoline plants in the state.

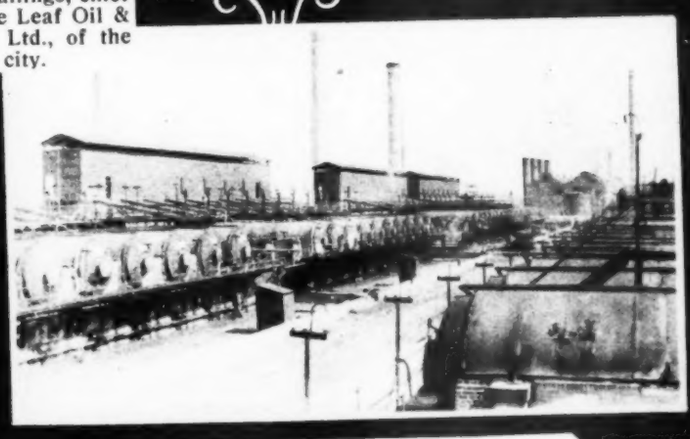


Left: H. C. Gathings, supt. vapor phase cracking unit, Hope Engineering Co., Coutts, Alberta, Canada. Right: K. R. Jallings, chief chemist, Maple Leaf Oil & Refining Co., Ltd., of the same city.

L. L. Smith (left) assistant superintendent, and D. R. Johnson, chief inspector of the Continental Oil Co. refinery at Glenrock, Wyo.

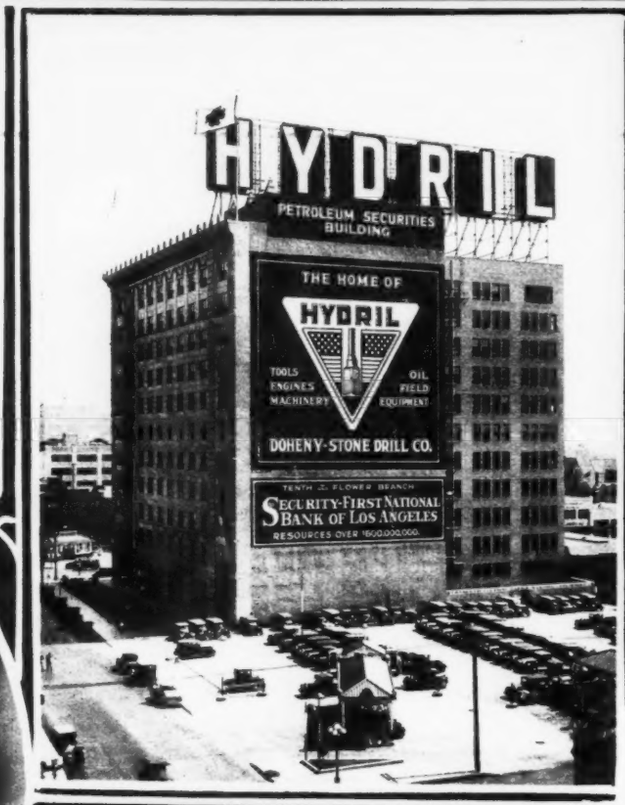


Midwest Refining Co. plant at Casper, Wyo.



Plant of Standard Oil Co., Casper, Wyo.

L. B. Riddle, vice president in charge of production, Deep Rock Oil Corp., Tulsa, Okla.



Petroleum Securities Building, Los Angeles, Calif., in which are general offices of Doheny-Stone Drill Co. and other oil field equipment manufacturers.

W. W. Scott, chief petroleum engineer, Humble Oil & Refining Co., Houston, Tex.

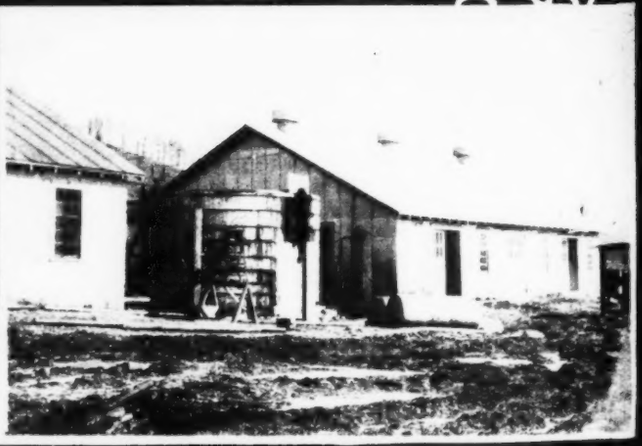
Lucien C. Sprague, executive vice-president of Dardalet Threadlock Corp., New York City

Richard K. Huey, general superintendent of production, Deep Rock Oil Corp., Tulsa, Okla.

W. B. Pearce, drilling contractor, Shreveport, Louisiana.

Gordon F. Hess of Central Alloy Steel Corp., Massillon, Ohio.

Signal Gasoline Co. staff at Big Lake, Texas. Front row, left to right—F. B. Haverfield, chemist; J. S. Hilligoss, chief engineer; J. E. Storts, treater; J. N. Garritson, plant operator. Back row—K. S. Ritchie, research engineer; E. L. Cook, connection foreman; L. A. Boyd, superintendent; W. W. Powers, clerk.

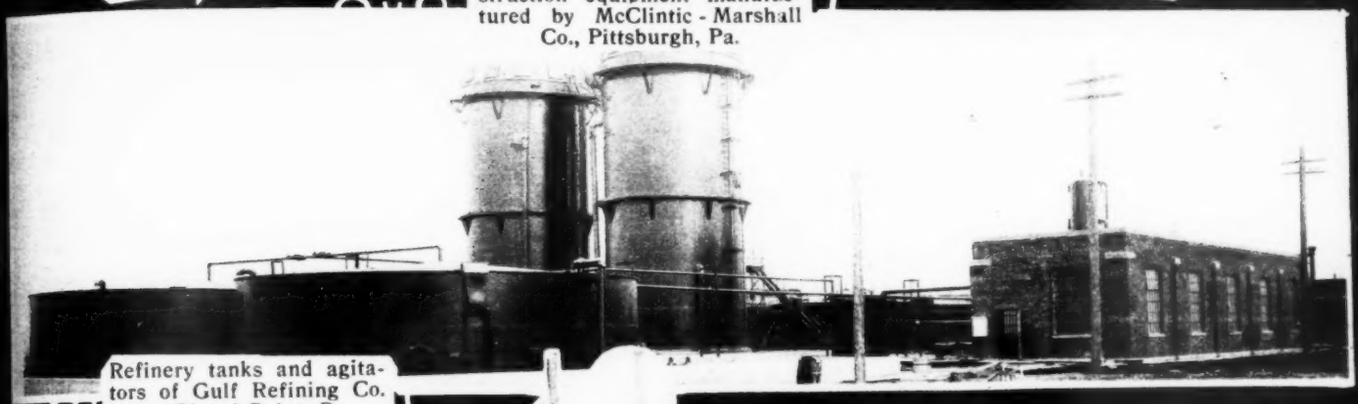


Messer Petroleum Corp.'s pumping plant in Bradford, Pa., field, used for water flooding.

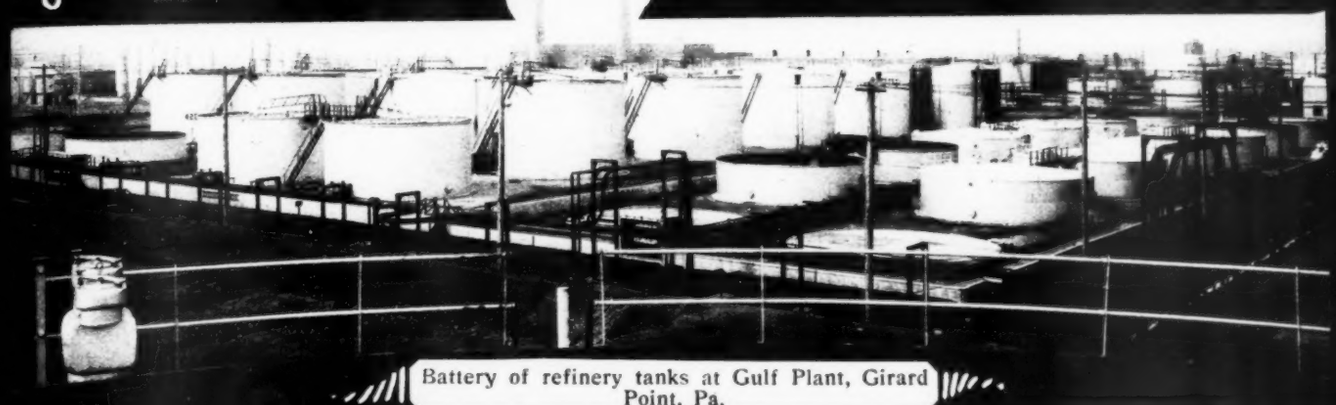
All welded pressure holders, 8500 bbl. capacity each, installed for Standard Oil Co. of La., at Baton Rouge.

500,000 cu. ft. pressure holders installed for Southern Countries Gas Co., San Pedro, Calif.

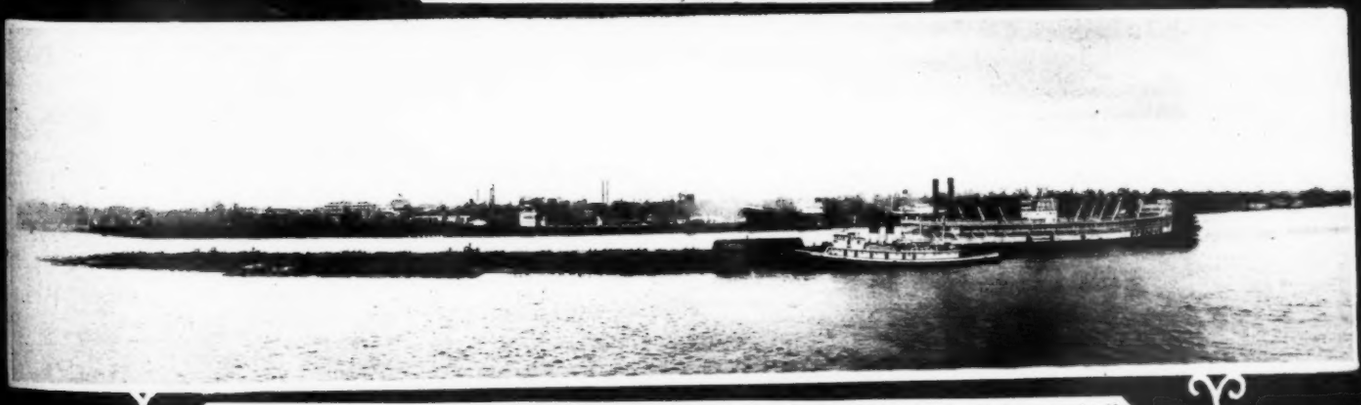
Pictures on this page show installations of refinery and construction equipment manufactured by McClintic-Marshall Co., Pittsburgh, Pa.



Refinery tanks and agitators of Gulf Refining Co. at Girard Point, Pa.



Battery of refinery tanks at Gulf Plant, Girard Point, Pa.



Standard Oil Co. of La.'s steamer Sprague with tow of 19 loaded steel oil barges built by McClintic-Marshall Co.

Tarpon Inn, a comfortable, well-conducted hotel that caters to sportsmen exclusively.

Air view of channel from Gulf of Mexico to Port Aransas, Ingleside and Corpus Christi. In background at left center are shown docks of Humble Oil Co. This is the world's largest crude oil port, having loaded since September, 1928, over eighty million barrels of oil in 1,110 ships.

Tanker J. O. Barstow of the Standard Oil fleet which holds the record of loading 120,000 barrels of oil and making the open sea in less than five hours.

Right — Barney Farley and, above right, Mrs. Farley who operate "Barney's Place," rendezvous for all deep sea fishermen. Here any kind of tackle can be purchased from minnow to the largest tackle required. The red fish, trout and pompano pictured with Barney represent a couple of hours fishing, while the kingfish and mackerel shown with Mrs. Farley were caught by her in less than an hour. Barney is secretary-manager of the recently reorganized Port Aransas Light Tackle Club, of which J. Ed Cotter is president and Gail Borden Musill is vice president. In order to become a member of this club, one must land a 4½ ft. tarpon to receive a silver button and a 5½-ft. tarpon to merit a gold button. The tackle is limited to a six-ounce tip and nine-thread line. The club is now planning a three-six division. The size of the membership of this club, now twenty, denotes the extreme skill required to land these fish under tackle requirements, when one takes into consideration that hundreds of fishermen angle for tarpon weekly.

Oo, la, la! We want to go back to Port Aransas.

Left to right—C. Morris, Tulsa, Okla., Don Farley, guide de luxe of Port Aransas and W. T. Bryan, Tulsa, with an hour's catch of kingfish.

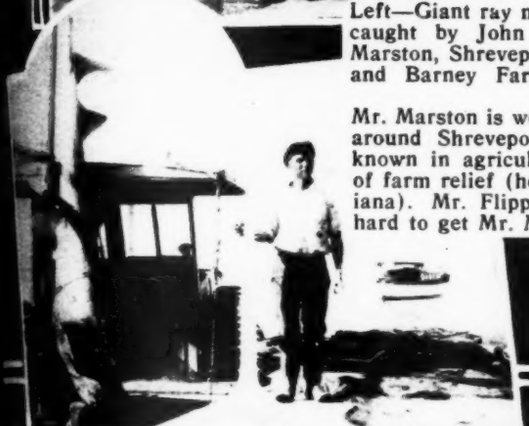
Oil men who are lucky enough to be located in the recently developed fields of the lower Gulf Coast can avail themselves of the finest fishing in the country at Port Aransas, Texas. Pictures shown on these two pages fall far short of telling the true story of this wonderful spot.

This shark gave birth to five little ones after it was landed. This fact can be vouched for by Thomas J. Brown, left, and Arthur M. Hyde, Secretary of Agriculture of the United States, who landed the fish.

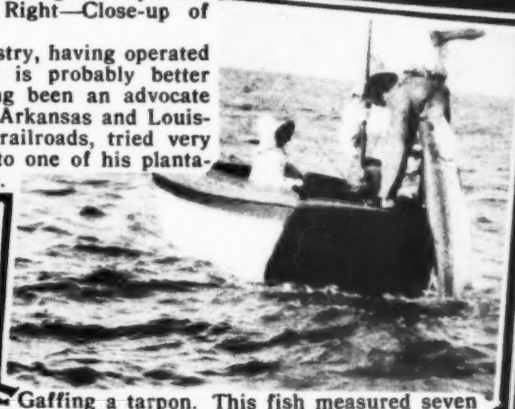
Old Bob, famous hammerhead shark, who long preyed on hooked tarpon about to be gaffed, until Bob Morse, Jr., Dallas, Texas, (left) put him on the spot.

Left—Giant ray measuring 16 feet from wing to wing recently caught by John R. Flippen, Memphis Tenn., left, B. W. Marston, Shreveport, La., who is shown holding the ray's tail and Barney Farley, guide, on right. Right—Close-up of mouth of the ray.

Mr. Marston is well known in the oil industry, having operated around Shreveport for many years, but is probably better known in agricultural circles, having long been an advocate of farm relief (he owns several farms in Arkansas and Louisiana). Mr. Flippen, being interested in railroads, tried very hard to get Mr. Marston to ship the ray to one of his plantations to feed the help.



Giant sawfish weighing over a thousand pounds and measuring 18 feet. A guide is holding the saw.



Gaffing a tarpon. This fish measured seven feet and weighed 160 pounds.

A beautiful leap of a tarpon. Note the distance of the jump.

The utilization of aluminum tanks for the transportation of gasoline, with regard to their non-susceptibility to explosion and durability against breaking, was demonstrated to a large gathering of sales and transportation officials of refining companies at the Aluminum Company's plant, New Kensington, Pa., recently.

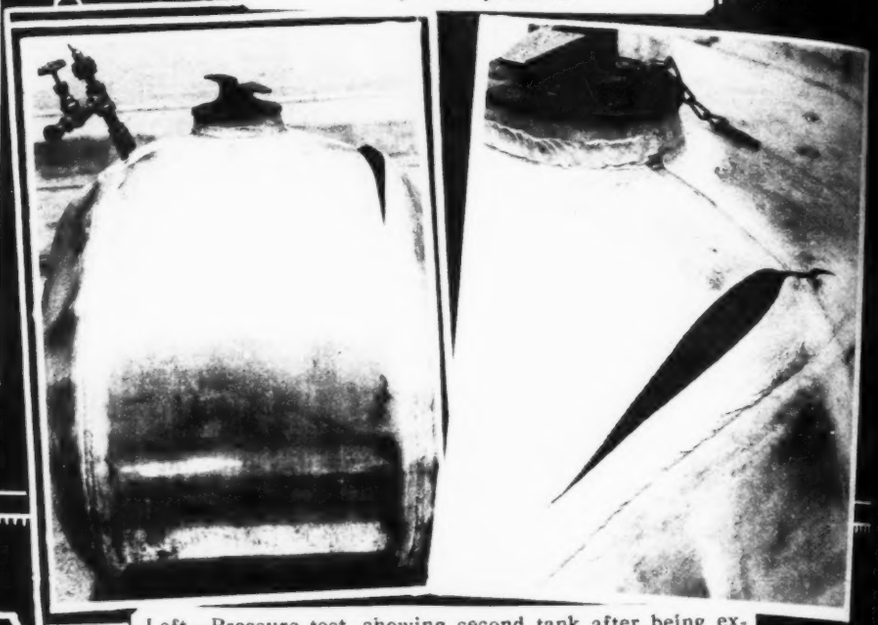
At the request of the National Fire Protective Association and fire insurance experts of that state who are to act on the safety of adopting the aluminum tanks for practical use, three demonstrations were made, revealing the strength of the new container when sustaining shock, resisting pressure and withstanding fire without exploding.

An all-welded aluminum tank of 147 gallons capacity was filled with water and lifted to a height of 25 feet and dropped. The impact caused no destruction to the tank, except for dingeing.

In a second test to determine the resistance of the container, water was forced into an empty tank. Exceeding capacity, the sides of the container bulged until a pressure of 216 pounds was exerted, whereupon the tank burst open.

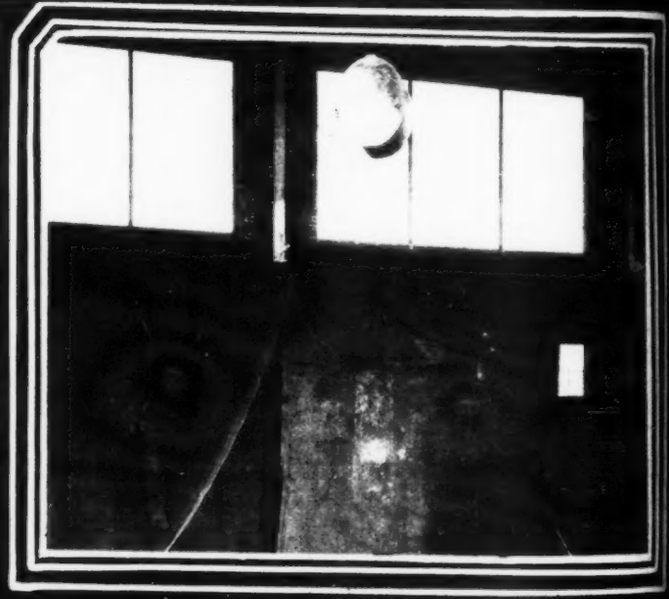
The most spectacular demonstration, exhibiting the non-explosive character of the aluminum tanks under fire, was held at the Hillcrest Country Club. Two tanks were filled with gasoline and placed over a bed of straw and oil, which was ignited. The flames spread around the container and melted safety jets which permitted the contents to escape. As the gasoline boiled out it ignited, while the thermometer soared to 805 degrees. The fire raged for over 20 minutes, with the tanks successfully withstanding the heat.

Pressure test: Tank subjected to 40 pounds city water pressure.

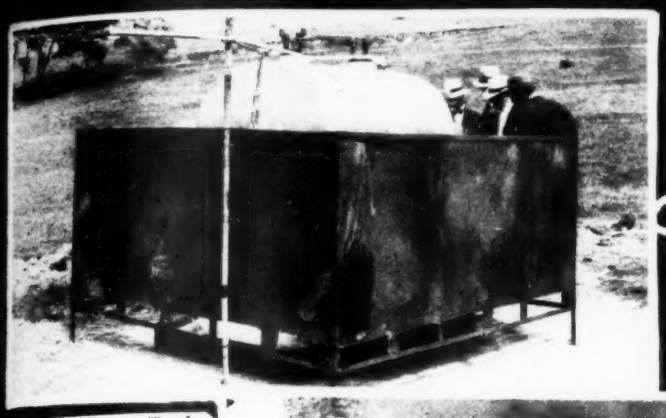


Left—Pressure test, showing second tank after being expanded to the rupture point. Right—A close-up of the rupture resulting from this test.

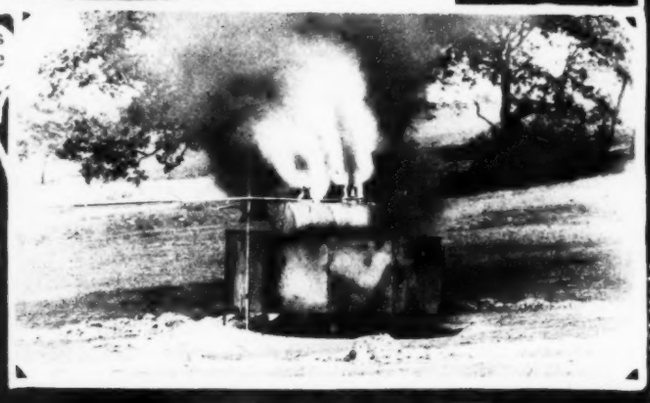
Drop test: Empty compartment tank-bottom.



Ready for the drop.

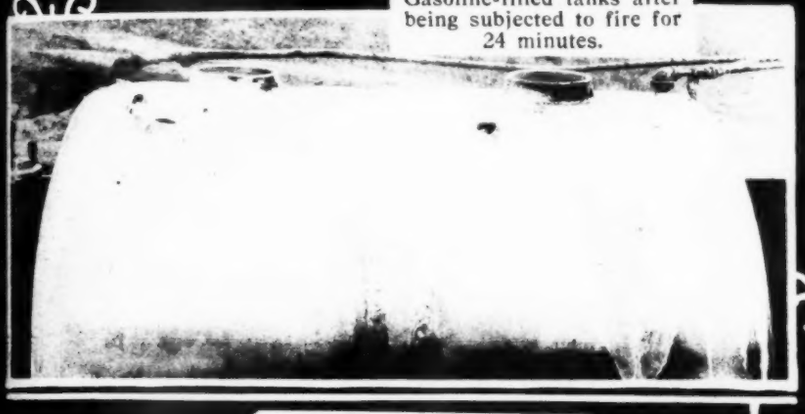


Fire test: Tanks and protective screen.



Andrew A. Kramer, president Columbian Steel Tank Co., Kansas City, Mo.

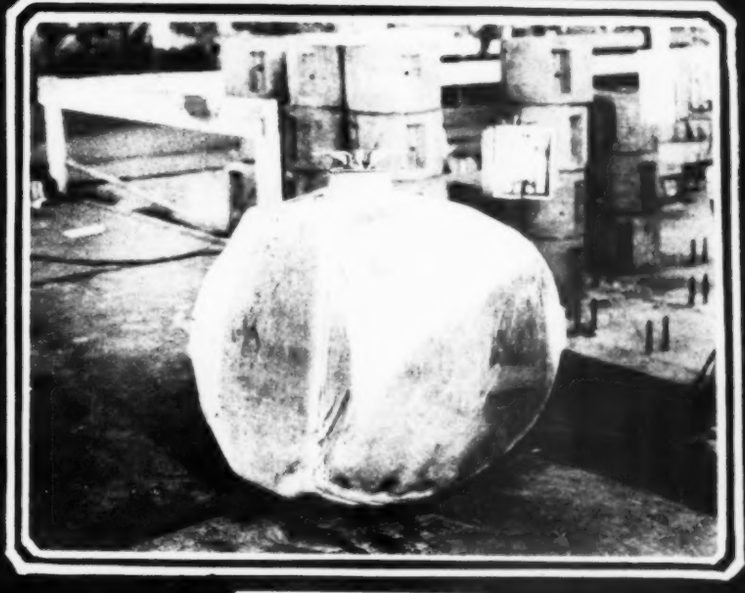
Gasoline-filled tanks after being subjected to fire for 24 minutes.



Tanks after fire; note ruptures.

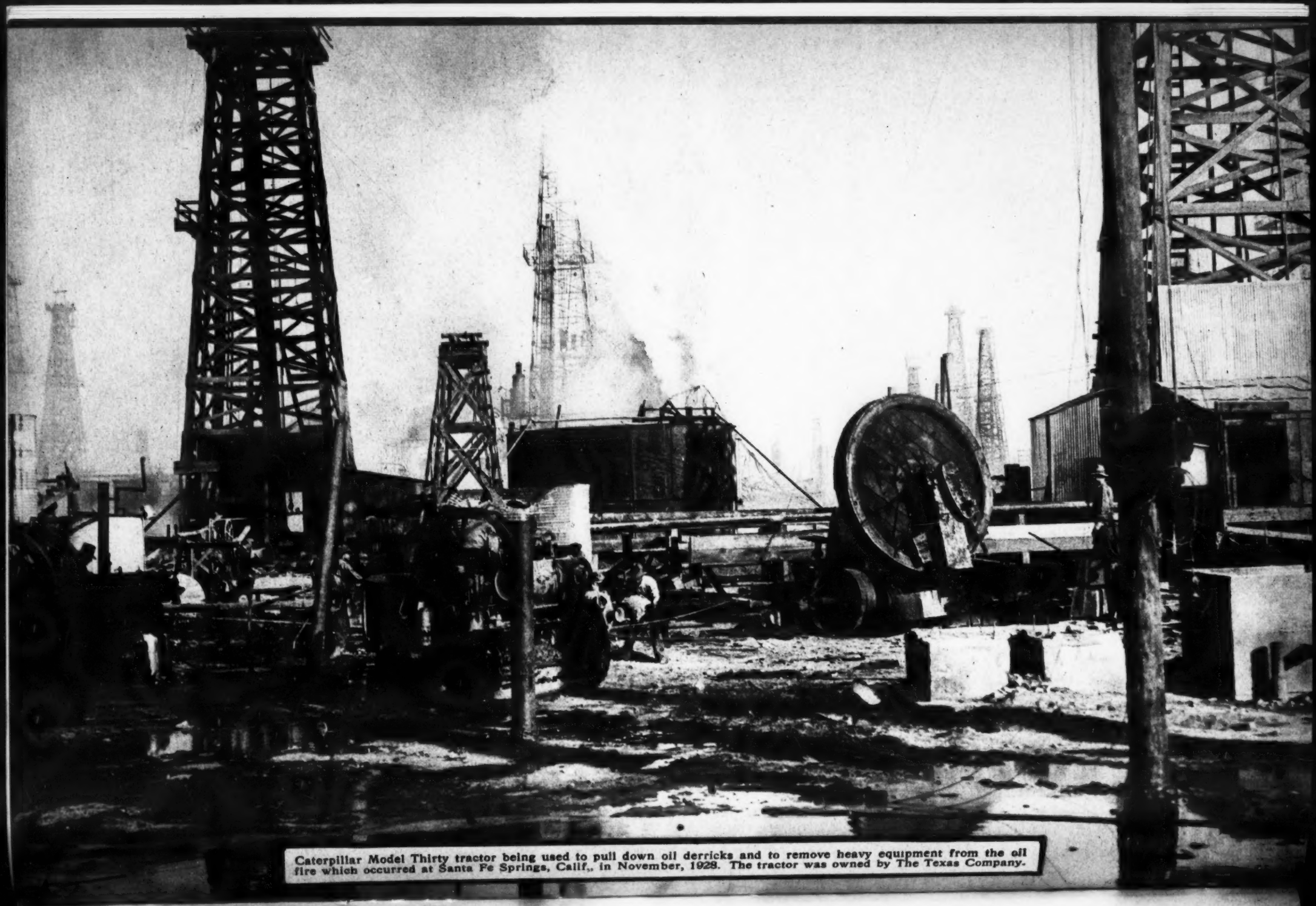
After 39 minutes.

Drop test: Crowd examining tank after first drop.



Tank after second drop.

PICTORIAL PETROLEUM FEATURE OF THE PETROLEUM ENGINEER



Caterpillar Model Thirty tractor being used to pull down oil derricks and to remove heavy equipment from the oil fire which occurred at Santa Fe Springs, Calif., in November, 1928. The tractor was owned by The Texas Company.

General view of station across pit.

Continental Has Simple But Efficient

Salt Water Station at Valley Center, Kansas

THE Continental Oil Company's salt water pump station at Valley Center, Kansas, although quite simple in construction and operation, has proven itself a very efficient unit. The salt water is separated from the oil in the gun barrels at various tank batteries in the field, whence it is carried by a system of gathering lines to a main line that runs to the pump station. It is then dumped into a concrete pit, from which it is pumped to Wichita and turned into the city sewage lines.

The capacity of the pump station is 20,000 barrels per day against a 550-pound discharge pressure, or 30,000 barrels per day against a 300-pound discharge.

At the present time a six-inch line, six and one-quarter miles long, carries the water to the sewer system. A pressure of 550 pounds is being maintained on the line. The company is contemplating the construction of a new eight-inch line, which would increase the capacity to 30,000 barrels daily.

The concrete pit is of 10,000 capacity. It is 80 feet square on top with sloping sides and is 10 feet deep. The walls are of six-inch concrete, reinforced with three-quarter inch sucker rods, crossed in nine-foot squares and wired together. The inside of the pit is not primed.

It is a monolithic job, having no expansion joints. The pit was made in one pour, requiring approximately thirty hours. The pit is symmetrical so that any expansion or contraction due to temperature changes, is taken throughout the hole. For this reason there is no sump or low part at the end under the pump suction.

The pumps, of which there are two, are of the three-inch, four-stage centrifugal type, powered by 150-horsepower electric type motors. The motors are equipped with across-the-line starters, having overload and time relay cutouts. The transformers are three 150-K. V. A.

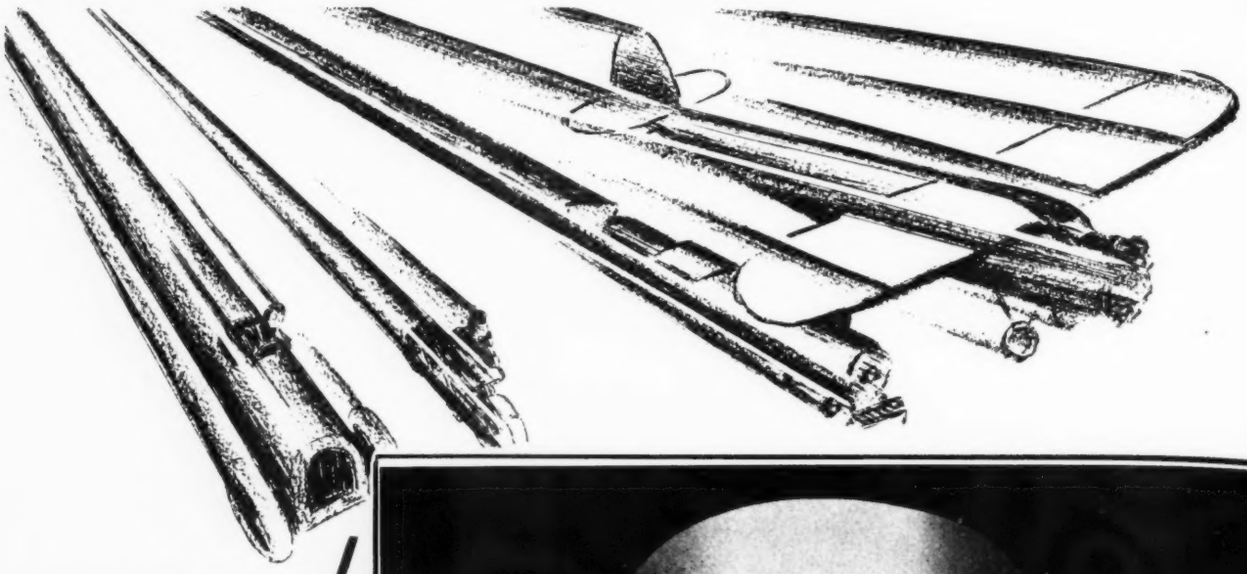
This sub-station is remarkably simple, complete, and yet inexpensive for its capacity.

The men in the picture, reading from left to right are: D. A. Swenson, of Swenson & Headlee; J. P. "Pat" Neel, district foreman for Continental Oil Company; H. G. Headlee, of Swenson & Headlee; E. H. Griswold, petroleum engineer with Continental; J. M. Miller, pump station operator, and Dave Abercombie, salt water foreman. Swenson & Headlee, petroleum engineers, constructed the station.

Above — The pump station and electrical installation.

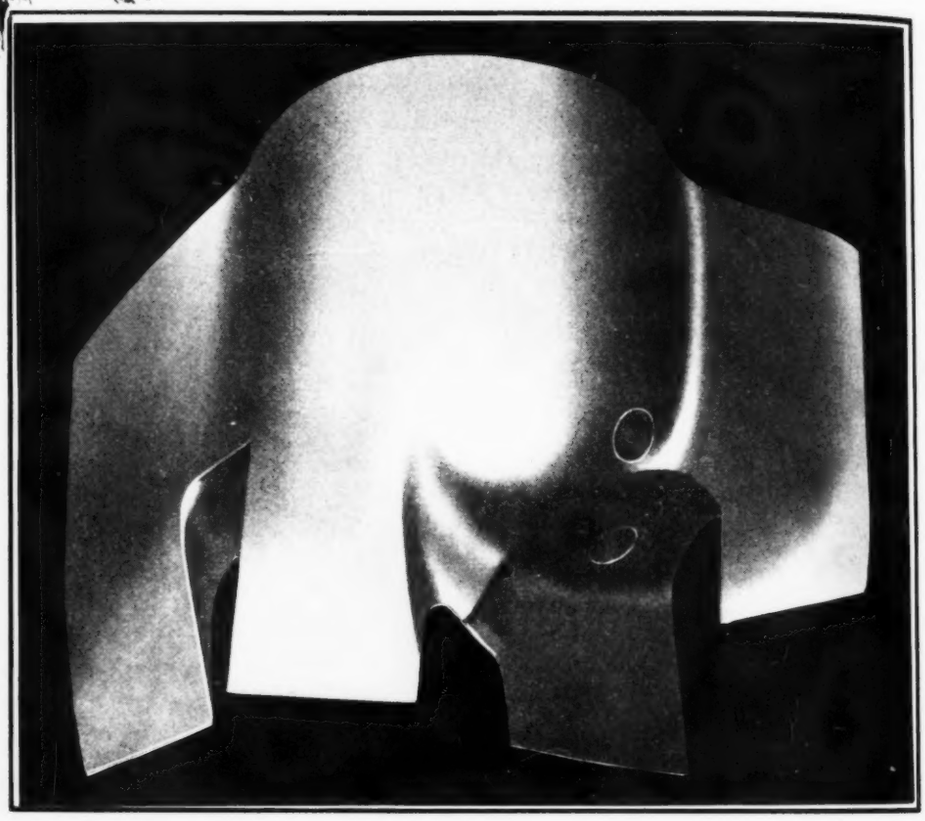
Right—Closeup of pit showing inlet and outlet lines.

Caterpillar Model Thirty tractor being used to pull down oil derricks and to remove heavy equipment from the oil fire which occurred at Santa Fe Springs, Calif., in November, 1928. The tractor was owned by The Texas Company.



SPEED!

...a record-maker in its own field



Elliott DRILLING BIT

This new Elliott Drilling Bit has set the pace in hole making performance, in many instances, since its recent introduction.

Runs in tough, sticky, and hard digging (not properly classed as rock bit digging) prove it particularly adaptable for this class of service; its use resulting in high speed, efficiency, economy of power, and smooth running.

Learn its many distinct advantages. Send for bulletin.

Elliott
CORE DRILLING COMPANY
4731 East 52nd Drive
LOS ANGELES, CALIFORNIA.

Export Office:
150 Broadway, New York

When writing ELLIOTT CORE DRILLING CO. *please mention The Petroleum Engineer*

Dewaxing Heavy Vacuum Distillate Stocks by the Filter-Aid Method

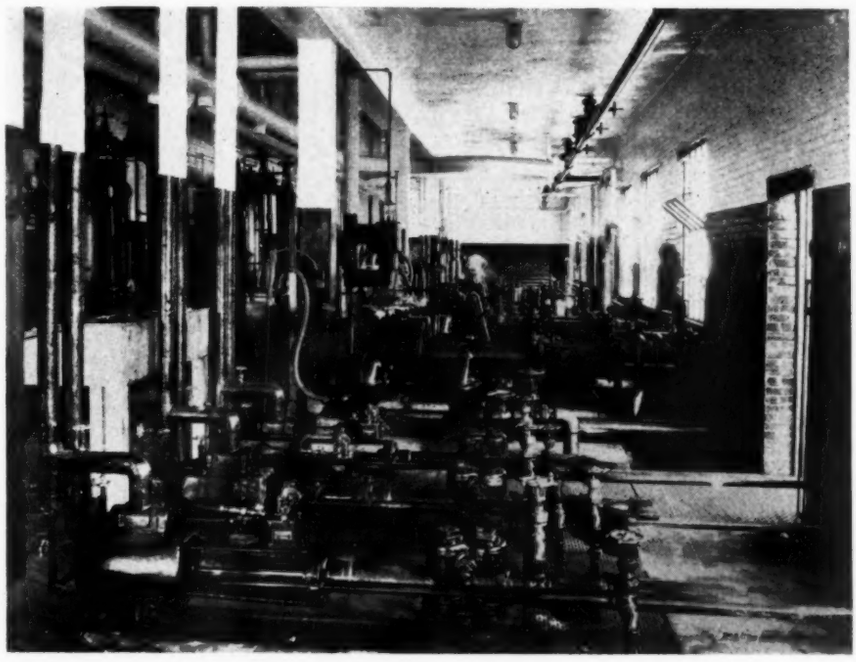
By WM. P. GEE[1]

DUE to the advent of the modern vacuum pipe still with its ability to produce distillate paraffin lubricating oils and stocks of high viscosity, considerable attention is being given the Filter-Aid Dewaxing Process as a means of finishing these stocks to cloud free low pour test lubricants.

Some refiners have already installed commercial plants and many companies are investigating the adaptation of the process to their needs.

Lubricating oils of Zero Pour Test (A. S. T. M.) and wax cloud free, at and below, this pour point are being produced commercially and the flexibility of the process has been so extended that it is now capable of dewaxing any type of oil, whether of distillate or residual nature, and of any viscosity.

The flexibility of the process is one of its chief advantages. Yields of dewaxed oils are high by this process due to the fact that, being a separation of wax by filtration, the operation lends itself to washing out and recovering oil from the separated oil-wax mixtures, which would otherwise be lost. With this process no difficulty is experienced in obtaining low pour test, wax cloud free lubricants from true vacuum pipe still distillates.



Pressure pumps and control room for cracking unit.

While at one time handling the filter-aid was rather a complicated system, now it has been so simplified that it is a minor part of the plant layout. No mechanical conveyors, such as belts, elevators, or screws, are necessary. A laboratory has been established in the East; considerable research work is being done there. Special type filters are being developed for this process.

Examples of some of the grades of paraffin bearing oils that are being dewaxed commercially by this process are:

Pennsylvania and Mid-Continent Neutrals, 280 to 300 viscosity at 100 degrees F., lowering pour test from plus 35 degrees F. to 0/-10 degrees F.

Vacuum paraffin distillate (intermediate or "slop" cut) 60 to 80 viscosity at 210 degrees F., dewaxing from 80 degrees F. pour test to 5/0 pour.

Vacuum overhead distillate cylinder stock (bright stock), finishing to 135 viscosity at 210 degrees F., dewaxing from 90 degrees F. pour test to 5/0 degrees F. pour test.

Vacuum overhead distillate cylinder stock (bright stock) which had been centrifuged, lowering pour test from 15/10 degrees F. to zero pour test and making finished oil that is absolutely brilliant and wax cloud free at temperatures as low as -15 degrees F., and on standing an indefinite period.

The above oils are, of course, in addition to the various types of residual oils that have been handled by this process for the past several years.

Oils are dewaxed either before or after chemical treatment and percolation or contacting.

The last example given, namely finishing pre-centrifuged overhead distillate paraffin bright stocks to low pour, wax cloud free marketable oil is of special interest, at present, to refiners who have centrifuges installed for dewaxing vacuum distillate lubricating oils and stocks. When centrifuging high viscosity distillates it has been found necessary to dewax the oil before color treatment, that is in the "dark" state. While this appears to facilitate the work of the centrifuge, experience shows that in some cases subsequent color treatment, involving the removal of tar and coloring matter (inhibitors of crystallization), frees sufficient wax to form a cloud after the oil has been stored at normal temperature. The wax which remains after centrifuging can be removed by filtering with a very small amount of filter-aid. High rates of flow are obtained, relatively small amount of filtering surface and practically no additional refrigeration is required.

As a specific example: An overhead distillate cylinder stock from a selected Mid-Continent crude, processed on a typical pipe still and vacuum fractionation tower was diluted with 70 parts naphtha, chilled and centrifuged, in the untreated or "dark" state, at -45 degrees F. temperature. The centrifuged solution had a gravity of 46 A. P. I. and

[1] Oliver United Filters, Inc.

KELLY-DEMPSEY & COMPANY

1222 Hunt Building

TULSA, OKLAHOMA

LOOK up our record as pipe line men. You will find your investment safeguarded. This is an asset that cannot be overlooked. Pipe lines must be built to withstand the elements of weather. We put years of experience behind every line. Let us pass this experience on to your next construction job.

We were awarded and now have under construction the 800-mile gasoline line of the Phillips Pipe Line Company from Borger, Texas, to East St. Louis, Illinois.

When writing KELLY-DEMPSEY & COMPANY, *please mention The Petroleum Engineer*

contained 73.7 per cent naphtha. The stock, reduced with fire and steam, had the following tests:

Gravity, 20.5 A. P. I.
Flash, 535 degrees F.
Fire, 600 degrees F.
Vis @ 210 degrees.: 170.
Vis@210 degrees F.: 170.
Pour Test: plus 10 degrees F.

This stock was treated and contacted with relatively small amounts of sulphuric acid and contact clay, with low treating losses; giving an oil of 4 N. P. A. color, low carbon residue, 135 viscosity at 210 degrees F., and plus 20 degrees F. pour test; but when this treated stock was in storage under normal atmospheric conditions for about twenty-four hours wax began to precipitate out and remain suspended in the oil, giving a cloudy product. Altering distillation and fractionation conditions, centrifuging temperatures and capacities, only altered the degree of wax cloud or length of time required for the wax cloud to form.

Taking the untreated, centrifuged stock solution direct from the centrifuges, adding 7 to 8 pounds of filter cell as a filter-aid per barrel of solution, and filtering through single X chain cloth by means of a special pressure filter, at a temperature of -18 to -16 degrees F., gave a production rate of 2 to 4 gallons of dewaxed stock per square foot of filtering surface per hour total operating time. This pre-centrifuged, filter-aid finished product was acid treated and contacted in the same manner that the centrifuged product had been. The 4 N. P. A., 135 viscosity at 210 degrees F. finished stock obtained had a pour test of Zero degrees F. (A. S. T. M.) and showed no indication of wax cloud formation after three weeks' storage under normal atmospheric conditions (average temperature 70 to 75 degrees F.). The finished stock was absolutely bright at all times.

When the cloud forming wax was isolated it was found to average about 140 degrees F. melting point in most all cases, and the amount removed averaged about 1.5 per cent to 2 per cent by weight.

On one installation, running a treated, pre-centrifuged vacuum paraffin distillate cylinder stock direct from the centrifuges to the dewaxing plant, about 4,300 barrels per day was filtered, lowering the pour test 5 to 10 degrees further and finishing a stock which remained bright and wax cloud free.

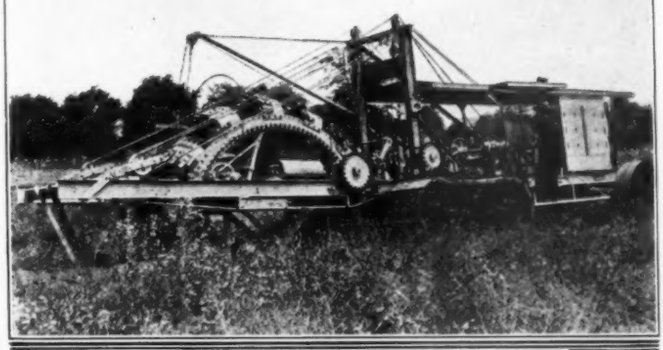
It would be interesting to cite a number of other examples, both commercial and experimental, of handling these vacuum distillate stocks, but one other example will have to suffice before concluding this brief article.

This was a mixture of the intermediate and heavy streams from a vacuum distillation unit, processing an Oklahoma crude, especially selected for high yields of low color, low carbon residue lubricants. The mixture of the distillates was treated with 20 pounds of 98 Be'. acid per barrel of stock, sludge settled, then contacted at 450 degrees F. temperature with 15 pounds acid treated clay, diluted, and the clay filtered off in a filter process.

For dewaxing purposes, the stock was diluted with 64 per cent of 59 A. P. I. gravity naphtha, giving a solution gravity of 44.2 A. P. I. This solution was chilled from 110 degrees F. to -25 degrees F. temperature at a rate of about 10 degrees per hour, and after chilling was mixed with filter cell to give an aid concentration of 30 pounds dry aid per barrel of solution. Filtering at -20 degrees F. temperature an average dewaxed stock rate of over 1 gallon per square foot of filter area per hour total operating time (commercial rate) and a yield of 80 per cent to 84 per cent finished lubricants of 5 degrees F. average pour test

See Buckeye Model 12 in Block "H" at the
INTERNATIONAL PETROLEUM EXPOSITION
Tulsa, October 4 to 11

BUCKEYE'S New Model 48



A BIG-POWERFUL-SPEEDY PIPE LINER

Cutting Widths: 22″ and 24″; 26″ and 30″; 37″ and 40″.
Cutting Depths: 6½′, 7½′ and 8½′.

Heavy duty, large cutting capacity and speed aplenty characterize Buckeye's newest Pipe Liner—Model 48. It will cut the biggest pipe line trenches most successfully and economically, through the toughest soils and in all kinds of weather.

That ability is assured by the fact that it is designed and built directly to the specifications of the world's foremost pipe line engineers and contractors. The leader in its field is mighty Model 48—just another addition to the comprehensive range of *Wheel-Type* Buckeyes—"*the* ditchers that meet *all* oil and gas field requirements."

Ruggedness is supplemented with remarkably easy (one-man) control. All favorite old operating features are retained, with many equally advantageous new ones. Profitable construction details include: Sturdy main frame—and no Buckeye main frame has ever broken; 95 h. p., 4-cylinder, industrial-type, medium-speed motor, which delivers plenty of power for ordinary needs, *plus* an ample reserve for all emergencies; the famous Buckeye digging wheel; multiple, quickly shifted digging speeds, ranging from 15″ to 134″ per minute; accurate grading ability, producing a cleanly finished trench at one cut; and Alligator *(crawler)* wheels, with traction brakes for safe operation on grades.

Our new Catalog, "BUCKEYE—*The Pipe Liner*", contains vitally interesting specification, mechanical and performance data for all prospective pipe line ditcher owners and users. May we send you a copy?

The Buckeye Traction Ditcher Co.
FINDLAY, OHIO

There's a Buckeye Sales and Service Office near You

for over thirty years **Buckeye**

When writing THE BUCKEYE TRACTION DITCHER CO. *please mention The Petroleum Engineer*

"WHEREVER PISTON RINGS ARE USED"

Power Rings
Cooktite
Cookoil
Sealing

Compressor Rings
Cookwiper
Cooksnap
Sectional

SEALING PRESSURES SINCE 1888

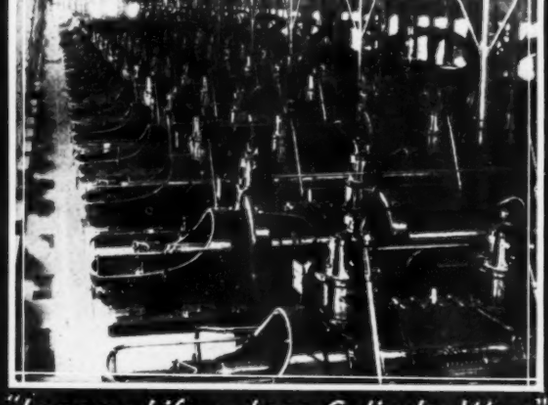
THE STANDARD
IN THE OIL AND GAS FIELDS

It is not merely to hold the pressure that should determine your selection of Piston Rings. You want the certainty that your cylinders will not wear unduly fast. You want, too, a piston ring of long life.

You can turn to COOK'S GRAPHITIC IRON Piston Rings with the assurance that whatever the service, wherever the gas engine, Diesel engine or compressor is located, these rings will provide complete protection against inefficiency.

Used by the representative operators in all Gas and Oil Fields, COOK'S Piston Rings are truly the Standard of the industry.

ASK FOR BULLETIN 130.



"Longer Life ~ Less Cylinder Wear"

C. LEE COOK MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.
TULSA NEW YORK LOS ANGELES
Agents in Principal Cities

(A. S. T. M.) was obtained. The following gives tests before and after dewaxing:

The finished oil was wax cloud free at all times. The data given above was taken on an operation where brine is used as a chilling medium and is limited to about -25 degrees F. temperature. Most modern plants are installing direct ammonia expansion systems, which will allow very low operating temperatures and capable of obtaining the lowest possible pour test. On the above stock an average filtering temperature of -30 degrees F. will result in a finished stock of Zero Pour Test.

	After Treatment	After Dewaxing
Gravity	23.1	21.7 A. P. I.
Flash	525	515 F.
Fire	605	600 F.
Vis/210 F.	119	134
Color	3	3½ N. P. A.
Pour A. S. T. M.	95	5 F.
Wax	23.0% of 125 F. melting point	unobtainable amount.

New plant designs offer compact arrangements, no mechanical conveying of the filter-aid, a comparatively simple system for the recovery of the filter-aid (which can be used over and over again for an indefinite period), new filter designs, and a totally enclosed system which reduces solvent losses and fire hazard to minimum.

Wickwire Spencer Enlarges Tulsa Office

THE Tulsa office and territory of the Wickwire Spencer Sales Corporation, Philtower Building, has been materially enlarged. This company, a subsidiary of the Wickwire Spencer Steel Company, New York City, handles wire, wire products, perforated metals and all other products of the parent company, whereas previously only wire rope sales has been conducted from the Tulsa office.

The Wickwire Spencer Sales Corporation is also handling screen cloth, hardware products and poultry netting of the American Wire Fabricating Company, another subsidiary of the Wickwire Spencer Steel Company.

The territory has been rearranged until it now covers seven states, namely: Kansas, Oklahoma, Texas, New Mexico, Louisiana, Arkansas and Mississippi.

Several new men have been added to the office or transferred. E. L. Stevens has been moved from New York and is in charge of the sales of all products for the entire district. L. J. Baldwin is handling the sales of the hardware products of the American Wire Fabricating Company. J. J. Lovell is still the head of all sales of wire rope. J. W. Carter is in the Texas Panhandle and selling articles in the Hobbs area. O. C. Elliott is at Wichita and Gene Sidwell at Oklahoma City, with R. E. Ratcliffe at Dallas, and I. J. Jones, Jr., at Abilene, Texas.

Several additional men are expected to be added shortly and the company will move to a new warehouse building in Tulsa. It will be able to carry a complete stock of products in the new warehouse under construction.

A Correction

On page 108 of the September issue of The Petroleum Engineer, in a story concerning a new gasoline plant which the Carter Oil Co. completed in the Seminole, Oklahoma, area, the following statement appeared, "The plant was designed and equipped by C. F. Braun & Co." This should have read, "The plant was designed by the gasoline department of the Carter Oil Co. and equipped by C. F. Braun & Co. and the Jackson Engineering Co."

When writing C. Lee Cook Mfg. Co. *please mention The Petroleum Engineer*

Examples of Dynamometer Analysis On Pumping Wells

By MOSE D. HODGES[1]

THE use of the sucker rod dynamometer as an aid in the proper counterbalancing of wells and in "trouble shooting" on wells with frequent rod breaks is becoming general as its value is more widely recognized. It is particularly adapted to locating mechanical difficulties that are causing excessive rod vibrations. The cards, of course, do not show just what the difficulties are, but they are of great assistance in isolating the trouble.

A well in the Valley Center Pool of Kansas was giving a great deal of trouble with rod breaks. It was equipped with 3-inch tubing and ¾-inch sucker rods and was operating with a polished rod stroke of 44 inches. The speed had been cut down to seventeen strokes per minute in an attempt to

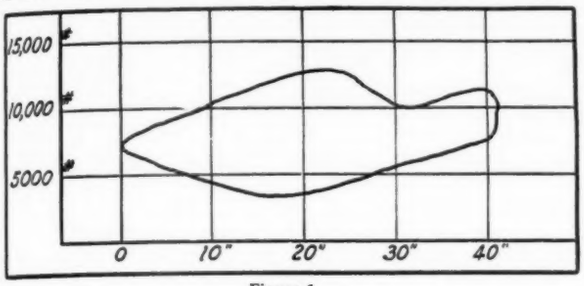


Figure 1
Initial card taken on well in the Valley Center pool. Rig running at seventeen strokes per minute.

eliminate some of the rod breaks and this, of course, cut down the amount of fluid delivered. A dynamometer test was made and Figure 1 was the first card obtained. The sudden drop at 30 on the upstroke showed that there was some sort of trouble in the rig. A search finally revealed that the clutch was slipping. This was repaired and another card was taken, with the result shown in Figure 2. The increase in weight was probably due to the well's filling up while the clutch was being repaired. The absence of irregularities in the card showed that rods were moving with a smooth motion, so the engine was speeded up to give twenty-four strokes per minute, and Figure 3 is the card taken at this speed, after the well had pumped down to its normal condition.

Simply tightening the clutch had eliminated the vibration that had caused six rod breaks in the ten days preceding the test. Only two breaks occurred in the thirty days following and there was a decided increase in both the oil and water production, due, no doubt, to the greater speed at which it was possible to run the rig after the difficulty had been alleviated.

Rod breaks were also the cause of trouble on a well in the South Ponca Field. The well seemed to be exceedingly heavy and a 35-55 horsepower electric motor had been in-

[1] Engineering Dept., Continental Oil Company, Ponca City.

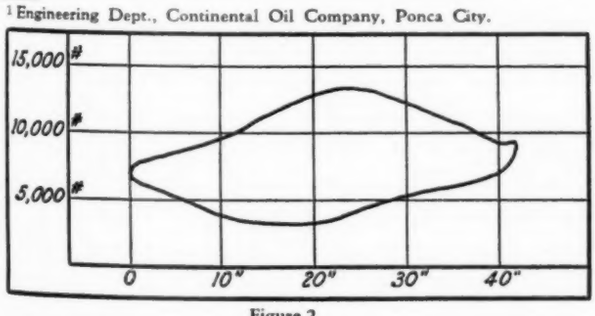


Figure 2
Card taken after rig was repaired. Seventeen strokes per minute.

SKINNER

IT'S SAFE!

with an Emergency Pipe Clamp

—the quick, sturdy repair for splits and rust holes in oil and gas lines. Absolutely permanent under any conditions. The established clamp for field use.

Made of malleable iron, in all sizes—1″ to 12″. Carried in stock by practically every Supply Store.

Write for Our New Booklet!

M. B. SKINNER COMPANY
Sample Street at Falcon St., South Bend, Ind.

The

MILLER SAND PUMP

INCREASES PRODUCTION

BECAUSE its suction cleans out more sand, mud, and sediment and allows oil to flow into the hole more freely.

The MILLER SAND PUMP is used as either a sand pump or a bailer by exchanging bottoms.

Chisel Bottom **Bailer Bottom**

Made in diameters of 2½, 3, 3½, 4, 4¼, 5, 5½ and 7 inch and 20, 25 and 30 foot lengths.

Write for our pamphlet

For sale by leading supply houses everywhere

Regular Sand Bottom Shown in Pump.

Manufactured by the

MILLER SAND PUMP CO.

General Office and Plant:

SAPULPA, :-: :-: OKLAHOMA

stalled. The dynamometer tests were made in conjunction with a high speed recording wattmeter, which was placed on the power line to the motor. The wattmeter indicated the power consumed by the motor, while the dynamometer indicates the pull required to lift the sucker rods. In this manner it was possible to detect the effect of changes in counterbalance on both motor and rods. Figure 4 is the first card taken. The tell-tale dip shows up at about ten on the upstroke. Weight was added to the grasshopper counterbalance until an additional twelve hundred pounds had been put on. Dynamometer cards were taken at intervals, and the wattmeter was recording continuously, so a check was had on the proper amount of weight to be added to the counterbalance. Figure 5 shows the card taken after 1,200 pounds had been added. The dip has been removed and a smoother motion has been imparted to the rods. The additional weight also caused the amount of power consumed by the motor to be decreased.

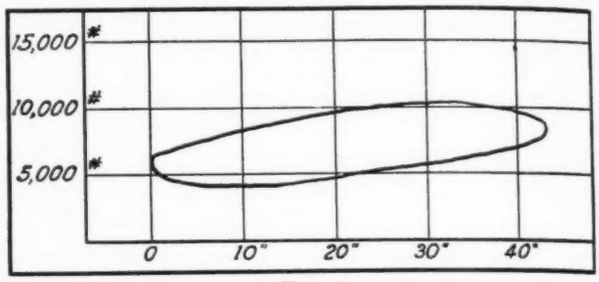


Figure 3
Final card on Valley Center well, taken after well had pumped down to its normal condition. Twenty-four strokes per minute.

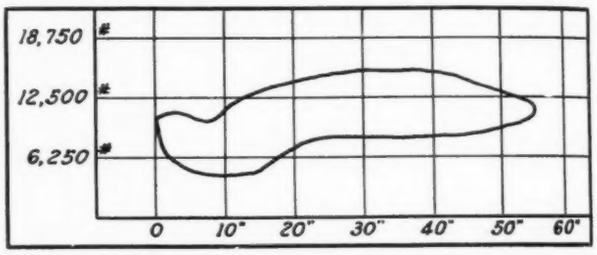


Figure 4
Initial card taken on South Ponca well. Twenty-two strokes per minute.

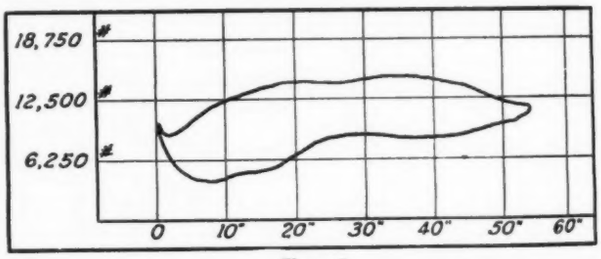


Figure 5
Card taken on South Ponca well, after 1200 pounds had been added to counterbalance. Twenty-two strokes per minute.

Bruzac Refining Process

A DESCRIPTION of the Bruzac Refining Process and the claims made for it appear in a recent article in the Petroleum Times (London).

The process is patented by A. Bruzac. Ozonized air, having a slight ozone content, is used for refining impure hydrocarbons. A stream of ozonized air at ordinary temperature and pressure is passed through the crude benzole or other hydrocarbon for a period not exceeding one hour. The ozonization is carried to a point where the unstable and easily oxidizable impurities are oxidized, but is stopped before the more stable compounds are affected. It is claimed to be applicable to cracked distillates and to crude benzol, and to be valuable in the treatment of lubricating oils.

When writing MILLER SAND PUMP CO. *please mention The Petroleum Engineer*

"Open Forum" to Be Featured at Oil Exposition

PROMINENT among the educational features of the International Petroleum Exposition is the Open Forum to be held October 10 and 11, in the auditorium on the Exposition grounds. Participation in the two-day session is open to everyone interested in the scientific and technical phases of the major branches of the oil industry. Production, natural gas and gasoline, refining and transportation will each come in for discussion.

Questions are invited and should be submitted to George B. Oberfell, who is chairman of the committee in charge of the Open Forum.

Recognized authorities will be present to answer any question propounded.

Great interest has been aroused among oil men in the session and the Forum is expected greatly to enhance the educational value of the scientific and technical display which, this year, is better and larger than ever.

Arrangements have been made by the committee in charge for a full attendance at the Open Forum.

Already a series of questions are scheduled for answering and discussion, and these include:

1. Vacuum Distillation of Lubricating Oils.
2. Sulphur Dioxide Treatment of Kerosene Distillates.
3. Continuous Acid Treatment of Lubricating Oils.
4. Cement and Mud Hydrometers for Drilling Wells.
5. Low Temperature Fractionation.
6. Use of Low Molecular Weight Absorption Oils.
7. Control Methods of Fractionation.
8. Crooked Hole Measurements in Wells.
9. Instruments for Measuring Crooked Holes.
10. Feasibility of Making Aviation Gasolines from Natural Gasoline.
11. Control of Oil Temperatures in Absorbers.
12. Determination of Vapor on Denuded Oil and Proper Operation of Steam Stills.

Those having questions to submit are urged to address them to George B. Oberfell, "Open Forum," International Petroleum Exposition, Tulsa, Oklahoma.

Republic Steel Receives Large Order

THE Republic Steel Corp. has received an order for 110 miles of electric welded steel pipe for shipment to large natural gas interests in the Southwest. The company now has all three units of its electric welding pipe plant at Youngstown at capacity operation, the last unit being started a few days ago. Unfilled orders on hand are sufficient to maintain a high rate of activity for the plant through the late fall, according to company officials.

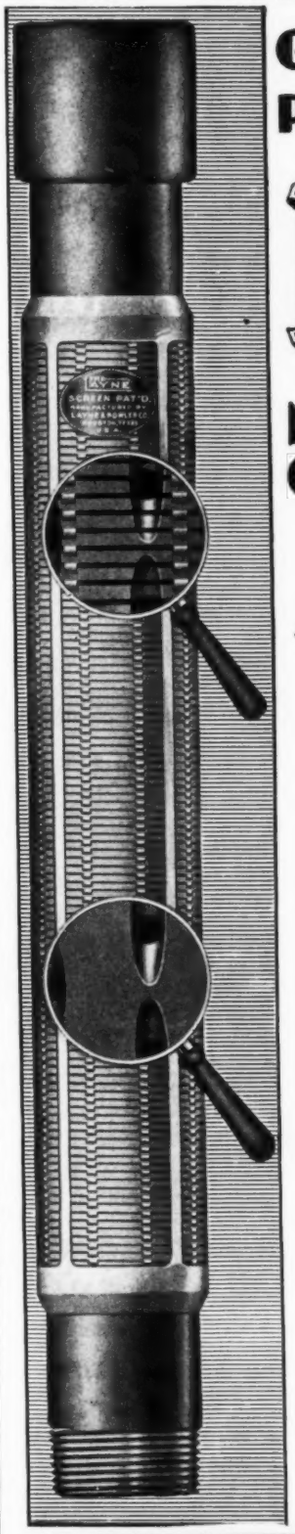
Landis Machine of Canada Changes Name

THE Landis Machine Company of Canada, Ltd., Welland, Ont., has changed its name to the Canadian Landis Machine Company, Ltd.

The company makes Landis chasers, also a complete line of Landis threading die heads, turret lathes and automatic screw machines.

J. N. Stickell is superintendent of the company and C. H. Gilland is special sales representative.

. . A HOLE
that Guarantees
GREATER PRODUCTION



THE LAYNE
MILLED GROOVE *screen*

A famous hole — the *Layne Milled Groove* — in a screen which increases production from 33 1/3% to 100%.

That's why the "greater production" *Layne Milled Groove Screen* was a sensational success at its inception, and that's why, today, this exclusive screen is used by leading companies abroad and in this country.

The *Layne Milled Groove Screen's* ability is remarkable, having the strength to safely stand 8,000 feet of drill pipe. It prevents sand cutting, is a tonic to low-pressure wells, and does not clog with mud and sand.

Install the "greater production" *Layne Milled Groove Screen* instead of wishing you had.

Write, wire or phone for quick service, prices or catalogue.

The Layne & Bowler Co.
Houston Texas
Install Milled Groove Instead of Wishing You Had

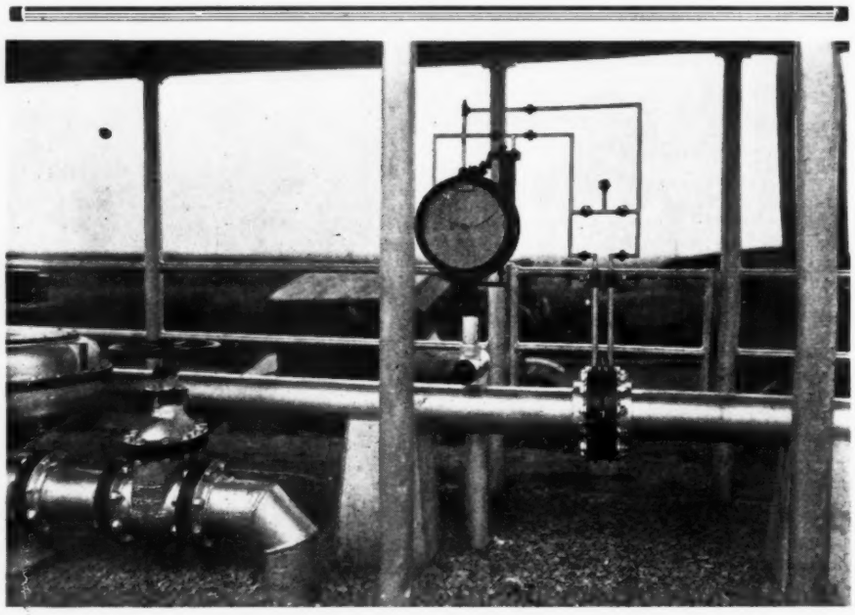
Difficulties *in* Operating Pipe Line Equipment *in the* Texas Panhandle

By MAX K. WATSON, *Gas Engineer, Canadian River Gas Co.*

THE necessity for close co-operation between the metering and operating departments of gas companies is especially marked in the Texas Panhandle. The distance between locations, the type of roads and weather conditions during certain times of the year are factors making this co-operation essential.

It is difficult for anyone not acquainted with this section to understand how long and rough a road runs from one location to another which appears, on a map, to be only five or ten miles apart. The Panhandle is always considered a flat country, but nature located approximately 500,000 acres of the best gas reserve in what is known as the Canadian River breaks. This broken country is as inaccessible in a car as the most rugged mountainous country, and extends ten or fifteen miles away from the river on either side. There are two graded roads as main arteries to that section of the field, one crossing the river due north of Amarillo, used as a main road to the area west of the river, and one running along the breaks to the east, used as a main road to the area east of the river around Fritch and Sanford. These roads are used for a distance of about thirty-five miles in both directions, along which trails lead off to the different locations, which may be as far as twenty-five or thirty miles from the graded roads. These trails are little more than "cow trails," following ridges and drainage draws, up and down steep, rocky ledges, following a general direction, but to a stranger, leading nowhere. There are no bridges on these trails, making it necessary to ford streams in all kinds of weather. These fords vary as the condition of the drainage bed changes, being moved for a mile or more up or down stream. It is readily understood how confused anyone may become if not accustomed to traveling on these roads. As a matter of fact, one crossing looks as good as another, but those who use the trails frequently are aware of quicksand and soft roadbeds which may look passable from the bank. The idea uppermost in one's mind in crossing these fords is to hit them fast, for a moment's hesitation in the middle may mean a walk of fifteen or twenty miles for a tow car and possibly a ruined car from the sand penetrating every working part. During some of the winter months these trails become almost impassable, due to the drifting snow, which also obliterates what roads there are. The writer, who has traveled these trails frequently for the last four years, had the experience of driving off one of them and ending up head first in a snow-filled draw, which appeared like level country.

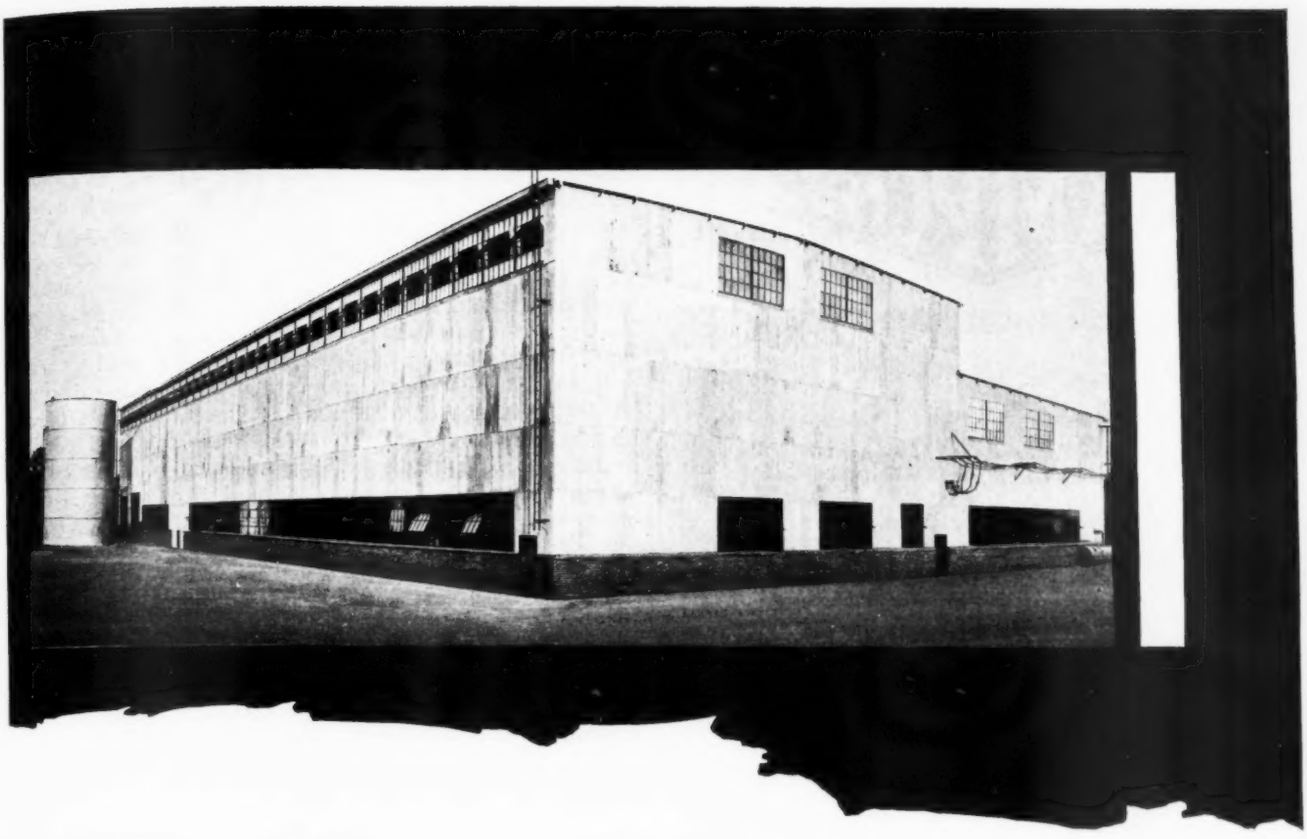
From the above description of road conditions it is evident that the chart changers, pressure men and others blowing drips, checking freeze-ups, etc., must work together and combine their responsibilities so as not to duplicate trips to the same sections of the country. This condition is further emphasized when it is considered that a location on one side of the Canadian River four or five miles from another is actually seventy-five miles by road, except during a very few weeks of the year when a river ford can be used.



Meter run in the Texas Panhandle.

The above discussion, of course, is a description of the worst conditions existing during the year. There are other favorable factors, such as an abundance of gas and ideal winter weather for weeks at a time, but the periods when the gas is most needed is the most difficult time to operate.

The changeable weather peculiar to this section necessitates a flexible operating policy, for it is not uncommon for the temperature to drop from seventy degrees to below freezing in a few hours, with a gas load changing just as rapidly. The gas line supplying Amarillo with gas has increased from three or four million cubic feet to a twenty-five-million peak in the short space of two hours, requiring each department to function at its best. This variation in temperature also works a double hardship on the metering equipment, in that it is not only necessary to measure the rapid changes and supply the required amount of gas, but also to keep the meters in working order. A great deal of difficulty has been experienced in overcoming the condensation of gasoline and water vapor in the meters and meter pots. A meter house heater seemed the logical solution, but the rapid changes accompanied by a high wind presented the problem of keeping the meters above freezing in zero weather and not too hot during the warm spells. It is impractical to expect a meter man to change the heaters in accordance with the temperature changes, since these



The Home of the American!

A New Factory and a Unique Structure

The new Factory of the American Tank & Equipment Corporation (formerly American Tank Company) has recently been completed.

This is a unique structure in that it is of all welded construction, which proves our faith in welding. It is one of the few buildings of its kind in the country, and the largest shop of its kind west of Chicago.

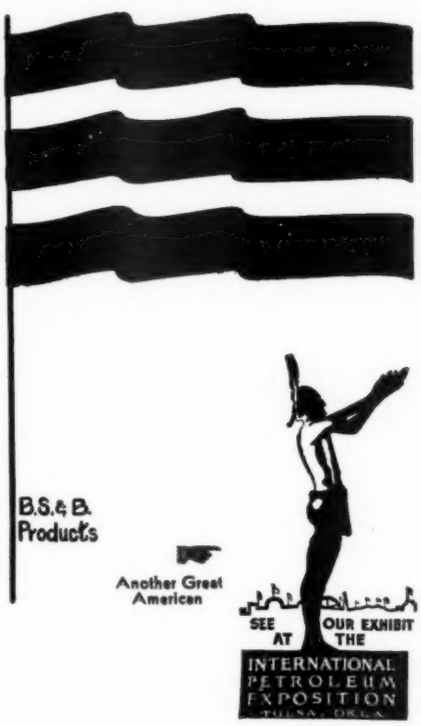
The building was designed by the Engineering Staff of Black, Sivalls & Bryson, the parent company of this concern, and the special equipment and devices have been *originated* to facilitate greater efficiency and more economical operation, which is of benefit to our customers.

The Manufacturing Subsidiary of "B.S.&B." and Producers of Other Equipment

The natural gas plant and refinery equipment designed by the newly created Refinery and Gasoline Plant Division of Black, Sivalls & Bryson are made in this factory, in addition to the Improved AMERICAN Oil and Gas Separators.

The American Tank and Equipment Corporation also manufacture welded field tanks, bulk storage and filling station tanks, heavy pressure vessels, smokestacks and numerous other welded or riveted products, which equipment is made to specification.

If in need of anything special in the way of tanks or equipment, let our engineers design something for you. Address Dept. CA-11.



See our Xhibition at the Xposition » »

American Tank & Equipment Corp.

A SUBSIDIARY OF
BLACK-SIVALLS & BRYSON, Inc., Bartlesville, Okla.

OKLAHOMA CITY — OKLAHOMA

(*Formerly* AMERICAN TANK COMPANY)

Introducing

AMPCO

PRODUCTS

to the Mid-Continent

AMPCO METAL, an electric furnace copper-aluminum steel alloy of superior merit, has for 15 years been produced by this company and used extensively by the largest industries in the middle west. Now, with the establishment of an office at 327 Exchange Bank Building, Tulsa, Okla., we are in position to offer Ampco Metal to the petroleum industry in the Mid-Continent, supplied in various hardnesses for requirements where ordinary metals fail.

Foundries in Texas and Oklahoma will be licensed to pour genuine Ampco Metal for local needs and quick delivery. Progressive Brass Mfg. Co. is licensed to pour genuine Ampco castings in Oklahoma and Kansas.

Chief among Ampco products produced for the oil industry are:

Ampco Corrosion Resisting Bronze

Ampco Bearing Metals.

Ampco Corrosion Resisting Valves, Stop Cocks, Pipe, Fittings, Sheets, Etc.

Ampco Gear Bronzes.

Ampco Non-Sparking Tools are standard in practically every industry where extreme fire hazards exist.

Write either to us or to our Tulsa office for literature describing our complete line

American Metal Products Co.

TULSA, OKLA.
327 Exchange Bank Bldg.
Phone 4-7164

MILWAUKEE, WIS.
34th Avenue and Burnham Street

changes may occur at any time of the day. The wind presented another difficulty, for at one time there would be a down draft on the heater stack and at other times a good forced draft, depending on the velocity and direction of the wind. This difficulty has been overcome by constructing a totally enclosed stove with a protected secondary air inlet outside of the house and a bend in the stack. The problem of meter house temperature has not been completely solved, but it is believed possible to maintain the temperature between forty and eighty degrees, with a few seasonable changes. A line heater ahead of the meter run did not overcome the condensation difficulties, since the gas in the meters was exposed to such a large cooling surface. The line heaters could not be economically constructed to maintain a uniform gas temperature on a large varying delivery. A hot water gas heater was installed at a town border station which solved the problem there, but the cost of installation and the danger of a freeze-up at a remote station made its use on well meters impractical. Several types of meter house heaters were tried with varying success. A hot air heater discharging directly under the orifice flange and meter was tried, but the ever-existing wind, which should have been an aid, seemed to blow from every direction, apparently deflected by the bluffs and canyons surrounding the location. A vaned ventilator was placed over the inlet air duct, but at times the meter house caught more wind than the ventilator and forced the air backward against a good draft.

This section, being a cattle country, probably has one problem not experienced in other fields. That is the depredations of cattle upon small gas lines, meter houses, regulators, fences, etc. Cattle will rub down and trample anything not planted several feet in the ground. One small meter house clamped on the run was installed at one meter station, which the cattle promptly knocked down. A surveying crew staked the survey for the helium line into Amarillo, and when the pipe line crew began construction they found that the cattle had knocked down and eaten a majority of the stakes. Drainage from drips cannot be left in pockets on the ground, for the stock will flock to drink this liquid and die immediately. From the cost of damage claims from this source, it is evident that only the best cattle in the herds are susceptible.

From the above discussion of roads and conditions it may be more easily understood why transportation expenses are a large item in operation costs, and field men will average thirty or forty thousand miles a year in covering their work.

NEW EDITORIAL FEATURES

STARTING with this issue of The Petroleum Engineer, some new editorial features are being included. A condensed review of the most interesting development in each state is given, and the active fields shown in color.

The construction of major natural gas lines and oil pipe lines is also treated in a concise manner, and the progress of each line shown in red.

These features will next month be amplified, and will also include a brief resume of each month's activities in petroleum refining, and the manufacture of natural gasoline.

OKLAHOMA CITY OFFERS UNEXCELLED ADVANTAGES TO THOSE WHO SERVE THE OIL INDUSTRY

▼▼▼

INVESTIGATE

THE very hub of this giant industry is Oklahoma City, where seven railroads operate 164 passenger and 64 freight trains daily, offering from seven to twenty-four hours quicker service than from any shipping point in the Mid-Continent. ▲▲▲ Three hundred and twelve cities and towns, representing all of the major pools in the Mid-Continent, are reached by motor-bus, passenger, express and freight service daily out of Oklahoma City ▲▲▲ Airlines from this central point give at-once service to the Wichita, Amarillo and other Texas fields. ▲▲▲ Oklahoma City offers every advantage to those who make their homes within its limits ▲▲▲ It has a six-million-dollar water works system, an abundance of natural gas and dependable, economical electric power from central power stations ▲▲▲ It boasts of eighty-nine schools, public and private and parochial, one hundred and eighteen churches and twenty-three acres of parks and public playgrounds. ▲▲▲ It is GROWING at the rate of twenty-five hundred people a month ▲▲▲ A fine spirit of friendliness and cooperation exists among its people and you'll like the way Oklahoma City folks do business ▲▲▲ Many firms, because of the geographical and the social advantages offered by it, have chosen Oklahoma City as the central point from which to direct their operations in the Mid-Continent field. ▲▲▲ Shipping and service problems have been completely solved by this move ▲▲▲ If you are interested in more detailed information about Oklahoma City and its relation to the Mid-Continent area, just address your request today to the Oklahoma City Chamber of Commerce, Oklahoma City, Oklahoma.

When writing OKLAHOMA CITY CHAMBER OF COMMERCE *please mention The Petroleum Engineer*

HOUGH PUMPING SPECIALTIES

BALLS AND SEATS
For Every Pumping Condition

"STEELEX"
For Sand

"REPELEX"
For Acid

"BRONZEX"
For Lodestone

"COMBINEX"
Sand-Lodestone

Hough Seamless Steel Working Barrels
Made to A. P. I. Specifications in all Standard Sizes.

Three Liner Working Barrels
Each One a Distinctive Type

TWO-CUP INSERTED LINER
Designed for Wells of Small Production

HUF-DUO PUMP
A General Liner Working Barrel That Sand Won't Trouble

LEWIS PLUNGER LINER
Plunger Works in Stuffing Box. No Cups.

WORKING BARREL VALVES
Made of Bronze or Steel. Sizes ⅞" for 1" tubing to 3¾" for 4" tubing. Four-six-eight cup upper or traveling. Two cup lower or drop. Leather ring lower. "Protex" upper. Extension lower with oversize ball and seat.

The Charles N. Hough Manufacturing Co.
Franklin, Pa.

INTERNATIONAL PETROLEUM EXPO.
TULSA, OKLA.
BOOTH 84
TEXAS BLDG.

Marathon Oil Company Outgrowth of Transcontinental

THE organizing of the Marathon Oil Company as a subsidiary of The Ohio Oil Company has been announced. This change is designed to identify the company more closely to its famous Marathon products.

The subsidiaries of the Transcontinental Oil Company, recently acquired by The Ohio Oil Company, will be included in the Marathon company. This will include the Transcontinental Oil Company (of Arkansas) and the Trans-Missouri Oil Company. The marketing division of the Mid-Kansas Oil & Gas Company, Ohio subsidiary in the Mid-Continent, which has taken over the producing end of the Transcontinental, will also become a part of the new Marathon company.

General offices of the company will be maintained in Tulsa. The company will be refiners and marketers of Marathon petroleum products.

The Effect of Holes and Cups on Belting

EVERY now and then the petroleum engineer hears or reads the claim that a multitude of holes punched through a belt will increase the belt's pulling capacity. The claim is also made that holes cut "half way through" will serve as vacuum cups and will increase the belt's capacity.

Neither claim is true. Holes through a belt simply make the belt weaker and thereby reduce its capacity. The contact area is reduced slightly, because where there are holes there certainly is no belt contact. Pulling capacity is proportional to the area of belt contact. It is claimed that holes are "air escapes"—a claim that has never been proven. Some hole enthusiasts also advocate drilling holes through the pulley rims so that solid belts can be used. That method, at least, does not reduce the capacity of the belt, but it is wrong both in theory and practice. Holes are of no assistance.

Let us analyze a belt having holes cut only half way through. It is claimed by advocates of that type of belt that a "vacuum" is formed in each "cup" and that the vacuum increases the belt's tractive power.

Herewith are four sketches showing a cross-sectional view of a single cup in a belt in four different positions. In position 1 is shown the cup approaching a pulley. The cup, of course, is full of air, for the same reason that a passenger coach running at a velocity of a mile a minute, or faster, contains as much air as when it is standing still. When the cup is in position 2 the action on the air in the cup is one of compression rather than suction. If holes punched clear through a belt permit air to escape, as is claimed, there would be slight compression of air in the cup, if anything. Then when position 3 is reached the air will still be in compression, provided we have good contact between the belt and pulley. If contact is poor the slight excess amount of air will escape. But during the period of escape the excess air would hold a part of the surface of the belt away from the pulley, causing poor contact. Whatever occurs, we can be sure that there is at least as much air in the cup in position 3 as in position 1. Lastly, in position 4, just as the cups leave the pulley there can be no suction or vacuum because the cup is still filled with air.

There is an automobile tire on the market with a tread that contains so-called "vacuum cups." That tire cannot be compared with a belt, because a road is flat and a tire is round. The area of contact is comparatively small and the rubber is probably compressed sufficiently to force some

Equipped

to do the JOB - - and
DO IT RIGHT ! !

Manufacturers of Electrical and Mechanical Devices
- and -
Instruments of Precision

Specialists in Model and Experimental Work and Quantity Production of small parts.

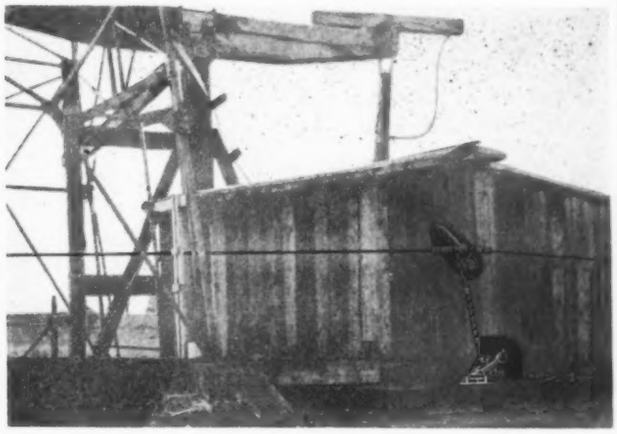
BART PRODUCTS COMPANY
Incorporated

Precision Machinists

« BARTLESVILLE « OKLAHOMA «

Coles Standard Rig Power Unit

Converts rig into perfectly balanced power. Down-pull grips rig together. Keeps shaft in place. Rod line thru power deflector can take off at any angle. . . .



Rig Power Pumping Four 3,500-foot Wells, all at the same time, with 25-H. P. Gas Engine

See the Petroleum Engineer, August Issue, page 154, for illustrated descriptive article on this installation

Export Agent: Oilfield Equipment Co., New York

THE PRODUCING EQUIPMENT CO.
TULSA OKLAHOMA

A typical Linco Super Service Station

LINCO

PETROLEUM PRODUCTS

"Linco Quality Never Varies"

LINCOLN OIL REFINING CO.
ROBINSON, ILLINOIS

subsidiary of

The Ohio Oil Company
PRODUCERS --- REFINERS --- MARKETERS

Gott
Water Cans & Coolers
Built to last... you will always be assured of a fresh supply of pure water, when you have a GOTT Water Cooler. Order one now from your supply store.
GOTT Water Cans 1½ gal.; 3 gal.; 5 gal.; and 10 gal.
GOTT Water Coolers 3 gal.; 5 gal.; 8 gal.; 10 gal.; and 20 gal.
Gotkool

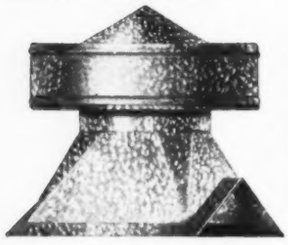
Keep Pure Water Always Handy

H. P. Gott Mfg. Company
WINFIELD, KANSAS

Southern Cornice Works

EVERYTHING IN SHEET METAL

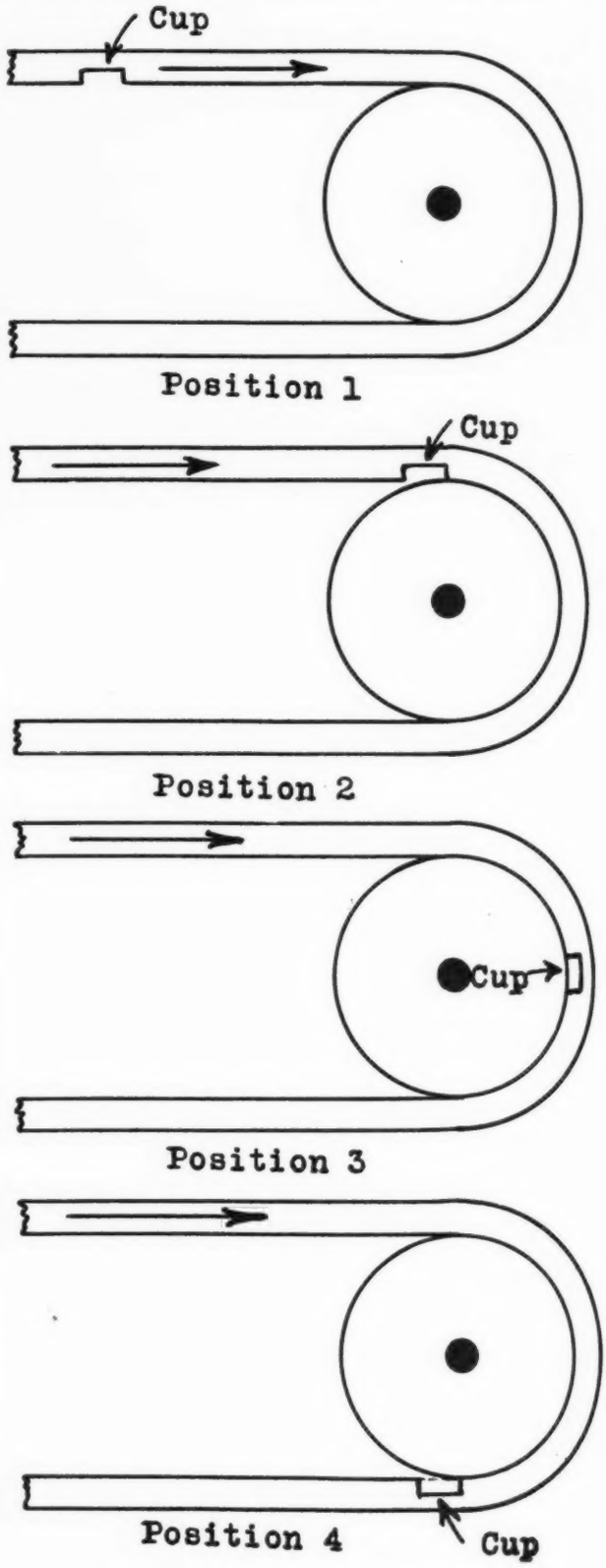
118-120 SO. CINCINNATI AVE.
TULSA, OKLAHOMA



Revolving and Stationary Roof Ventilators
Metal Adjustable Flues for Lease Houses
Water Well Tubing
Galvanized Storage Tanks for Drinking Water
Galvanized Iron Spouting That Your Lease Foreman Can Erect

SHEET BRASS, SHEET ZINC AND COPPER

of the air out of the cup. It may be true that a vacuum is formed. At any rate those tires are noisier than others, and it is said that the noise is caused by suction between the tire and the road. On the other hand, a belt is wrapped around the pulley. There is no appreciable compression, no vacuum, no suction. So let us also dismiss the vacuum cup idea. First-class plain belts containing neither holes nor vacuum cups will pull more, will cost less, will last longer, and will be more satisfactory in every way.



Four positions of a cup on a belt passing over a pulley.

Institute to Publish Bibliography on Sulfur Compounds in Petroleum

THE American Petroleum Institute is publishing, as a service to the petroleum technologists of the country and others who may be interested, and without profit to itself, a bibliography on sulfur compounds in petroleum.

Publication of the book developed from association of Dr. Parry Borgstrom with a fundamental research project on sulfur at Johns Hopkins University under the direction of Dr. E. Emmet Reid and financed through the Institute by funds donated by John D. Rockefeller.

Dr. Borgstrom began the collection of sulfur references, and after his connection with this project ended, this work was continued. The bibliography is the result of the collaboration of Dr. Borgstrom, now with the Naval Research Laboratory, Anacostia, D. C.; Dr. R. W. Bost, Professor of Chemistry, University of North Carolina, Chapel Hill, N. C., and Dr. D. F. Brown, Librarian, Standard Oil Development Company, Elizabeth, N. J.

The bibliography, of 250 to 300 pages, will contain nearly 4,000 literature and patent references to sulfur compounds which may occur in petroleum, and to their properties, uses, and methods of removal. No attempt has been made to include references to sulfur compounds containing nitrogen, sulfur dyes, or biological sulfur compounds, especially where monographs are already available.

Will Assemble Data on Natural Gas Conservation

PRELIMINARY steps have been taken for the assembling and correlation of data now in the United States Bureau of Mines in any way bearing upon the subject of natural gas conservation, in accordance with the resolution on this subject adopted by the Natural Gas Department Convention at New Orleans last May.

Representatives of the American Gas Association and the Bureau of Mines met in Washington several weeks ago and as a result of this conference economic and technological outlines covering the entire range of the problems that might be considered in this connection were drawn up. These outlines, together with a statement of the general purpose of such a conservation survey and study have been submitted to Chairman H. C. Cooper and members of the Main Technical and Research Committee of the Natural Gas Department, as well as to numerous executives of natural gas companies interested in this very vital subject, with the result that the Bureau of Mines has been asked to assign some one of their engineers to the task of assembling and arranging all of the data available for presentation to Mr. Cooper and his Committee in time for them to decide upon the main objective of this natural gas conservation program, which they will recommend to the American Gas Association Convention at Atlantic City in October.

E. L. Rawlins has been designated by Dr. Scott Turner, Director of the Bureau of Mines, as the engineer to handle the work of assembling this information. Mr. Rawlins is well known to the natural gas industry, having been one of the natural gas engineers at the Bureau of Mines Station at Bartlesville, Oklahoma, for the past several years, and is familiar with every detail of the natural gas phases of the Bureau's research and investigation, and will work in full accord and understanding with the Main Technical and Research Committee in preparation of the material necessary for their report to the October Convention.

DEPENDABLE REGULATION
Now or Eventually ?
Chaplin-Fulton Gas Regulators have proved their claims for efficiency by their service records in all types of control conditions. Engineering skill has labored more than 40 years to bring these regulators to the peak of reliability. C-F performance the world over shows this skill has been rewarded. The Gypsy Oil Co. employs C-F regulators at their Earlsboro, Oklahoma, plant. Why not put these regulators to work on your job today, and in this accepted way obtain the most effective regulation available to you?
Our catalog will give you complete information concerning this equipment.
THE CHAPLIN-FULTON MFG. CO.
28-40 Penn Ave. Pittsburgh, Pa.
CF

PENNSYLVANIA
FORGED STEEL WELDING FLANGES

We carry a complete stock of all types and sizes of PENNSYLVANIA FORGED STEEL FLANGES, including high hub welding flanges, for prompt shipment from our Tulsa warehouse. Ask for complete information.

PENNSYLVANIA FORGED STEEL WELDING FLANGES

"The strength of the line is only the strength of the flanges"

Distributed by

Hanlon - Waters, Inc.

General Offices: Tulsa, Box 1404

Houston Fort Worth Midland, Texas

Oxygen *and* Liquid Petroleum

By E. L.

THE scrapping of battleships, steel railroad cars and gondolas, steel smoke stacks or obsolete structural shapes of iron and steel is an easy task since the advent of the cutting torch.

The cutting off of risers and the scarfing of billets in foundries; the preparation of pipe ends for welding, or the trimming of structural shapes, are operations made economical by the introduction of hand and machine cutting torches.

Many fuel gases, such as acetylene, hydrogen, city gas and natural gas, in conjunction with oxygen, have been employed efficiently and profitably in metal cutting operations.

Since the introduction of butane, iso-butane and propane, by several of the large oil companies, these liquid fuel gases have been called to the attention of the metal cutting industry.

Much controversy has arisen as to which of the available fuel gases is most efficient and most economical for metal cutting operations with torches. It shall not be the object of this article to enlarge upon the already existing differences of opinion. It is our purpose to discuss the applicability of liquid petroleum gases for metal cutting and to give a short resumé of the process upon which metal cutting, with a torch, depends.

The process of natural oxidation or rusting of steel and iron can be hastened tremendously with the application of heat and pure oxygen.

The cutting process is, therefore, nothing other than a hastening of nature's invariable oxidizing effort, properly controlled in regards to time and suitably confined as to space direction.

The cutting torch is essentially a welding torch which is provided with facilities to direct a free stream of pure oxygen upon a localized and preheated surface area of the metal to be cut.

We are, therefore, confronted with two reactions.

The primary one confines itself to the creation of a properly directed flame or flames, of sufficient temperature and heat quantity to raise the temperature of the iron or steel, which is to be cut to kindling temperature.

The secondary process requires the direction of a stream of pure oxygen, at suitable pressure and volume, upon the preheated surface area.

Provided, therefore, that the restricted surface area of the metal has reached kindling temperature, the free stream of torch oxygen will cause instant oxidation of the iron. If the torch preheating flames are of sufficient temperature and calorific value the free stream of oxygen will do the rest.

Now quite obviously the fuel gases previously mentioned vary as to ultimate combustion temperature and B. T. U. value. The temperature of the oxy-acetylene flame is usually quoted at 6300° F., but its B. T. U. value is only 1624.

The approximate flame temperature of liquid petroleum gases lies in the neighborhood of 4000 degrees F., but the B. T. U. value, in combustion with oxygen, ranges from approximately 2800 to 3200. In other words, what the liquid petroleum gases appear to lack in temperature they possess in heat transfer ability.

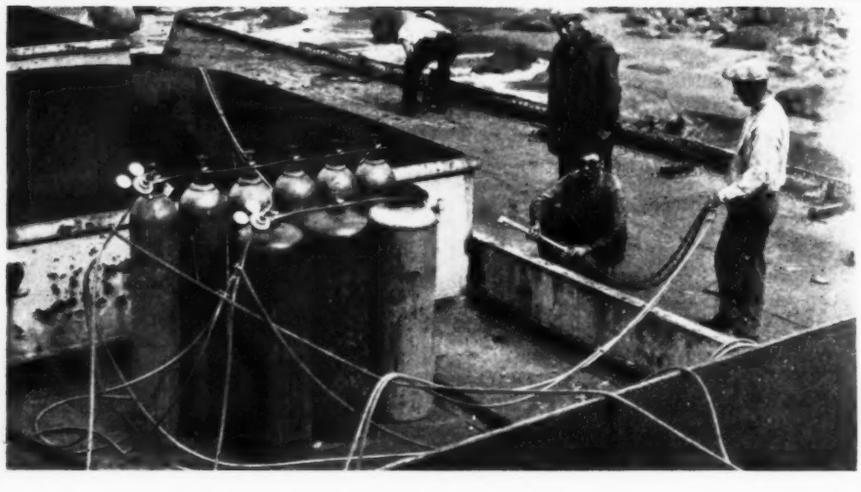
Let it be understood that both of the two fuel gases, acetylene or liquid petroleum gas, are adequate for the proper functioning of suitably designed cutting torches and that the amount of free oxygen needed for the oxidation of the iron will remain unchanged, no matter which suitable fuel gas is employed in the torch preheating flame.

The element of cost comparison is, therefore, definitely confined to the relative amounts and costs of the fuel gases required in the preheating flame and that amount of oxygen which is used exclusively to support preheating flame combustion. The final factor of cost is, furthermore, influenced by the starting time required to preheat the metal to be cut to kindling temperature.

With suitably designed equipment, which takes into consideration the characteristics of the fuel gas so as to compensate for flame propagation speed and density differentials, the relative starting time can be practically equalized. As a matter of fact, for average metal cutting operations, the starting time differential, where it does exist, is infinitesimally small in comparison to the time necessarily used by the operator in preliminary activities which have nothing whatsoever to do with the actual cutting.

The chemical formula of oxy-acetylene or propane-oxy combustion gives definite indication as to the relative amounts of oxygen which are consumed strictly within the torch preheating flames.

$$C_2H_2 + 2O\ (\text{torch}) = {}_2CO + H_2$$
$${}_2CO + H_2 + 3O\ (\text{air}) = {}_2CO_2 + H_2O$$



An example of ship-scrapping operations conducted efficiently with liquid petroleum gases and oxygen and hand cutting equipment.

1 Vice-President, Victor Welding Equipment Co.

Gases *for* Metal Cutting Operations

MATHY[1]

or/and one part acetylene plus one part torch oxygen, one and one-half part atmospheric air oxygen for final combustion. 1:2.500

$$C_3H_8 + 30 = {}^3CO + H_8$$
$${}^3CO + H_8 + 70 = {}^3CO_2 + {}^4H_2O$$

With propane the demarcation between torch oxygen and atmospheric oxygen consumed in primary and secondary combustions is not as defined. Much depends upon proper flame adjustment and the torch construction.

In other words, the relative torch oxygen consumption may be increased by supporting secondary combustion which should draw upon atmospheric oxygen for greatest preheating flame torch oxygen economy.

Actual shop observations have indicated that the cutting torch propane consumption is approximately 1/3 to ½ of that of acetylene under identical cutting conditions. The comparative speed of starting time and speed of cutting, with suitable apparatus, is identical.

With the previously stated considerations in mind, one may conclude that the total oxygen consumption per cutting operation will not vary materially and is apt to be in favor of liquid petroleum gases. Since both the oxy-acetylene flame and propane-oxy flame consume both torch oxygen and atmospheric oxygen it is essential that proper flame adjustment be maintained, both from a viewpoint of flame efficiency and proportionate torch oxygen consumption in the preheating flames.

The liquid petroleum gases now marketed for metal cutting purposes by such companies as Skelly Oil Co. (Skelgas); Standard Oil Co. (Calol and Flamo); Phillips Petroleum Co. (Philfuel) and Shell Oil Co. (Shellane) are supplied in suitable cylinders in liquid form. The vapor point of these liquid petroleum gases lies sufficiently low to cause volatilization at practically all atmospheric temperatures encountered, either in winter or summer weather, within the United States and the average pressure maintained in these cylinders is from 100 to 150 pounds per square inch. Suitable pressure regulators reduce this cylinder pressure to a working pressure range from between 1 pound to 10 pounds.

These cylinders contain from approximately 650 to 850 cu. ft. of gas and since the gas consumption is exceedingly low in comparison to other cylinder gases, cylinder handling expenses are reduced to a minimum. An interesting consideration is the fact that these liquid petroleum gases have an exceedingly narrow explosion range, whereas, that of acetylene covers almost the entire range of acetylene—oxygen mixture percentages.

Liquid petroleum gases will not supplant the exceedingly efficient acetylene but for extensive cutting operations or where cylinder freight plays an important factor, liquid petroleum gases will find a ready market. A comparison with liquid petroleum gases against other known fuel gases for metal cutting will show as many variations as are found in comparison with one of these fuel gases when used in conjunction with skillful or unskillful operators or with properly or improperly designed equipment.

Secure your information from sources capable of presenting the facts intelligently and if possible from those who may be expected to be unbiased.

There are many large institutions who found it exceedingly advantageous to use propane; others find it not suited to their requirements. The same is true, however, in regard to any other fuel gases; or for that matter in regard to any manufacturing methods.

After all, we drive different automobiles, use different sales methods, and live the life most suited to our own individuality.

An example of heavy cutting with Liquid petroleum gas and oxygen and Victor machine cutting torches.

Improved!
Approved!

AC—ME
ACCURATE MEASUREMENT

GRAVITOMETER

This device measures the specific gravity of either natural or artificial gas, and records it continuously. It's more accurate and more dependable than man, working automatically, day and night, rain or shine.

The GRAVITOMETER is sensitive to all changes of specific gravity. If that of your gas is fluctuating, or you secure gas from different sources, it is advisable to have one.

Practically no attention is required, and these instruments are designed so that they can be accurately operated in the field and occupy but little space in the meter house.

Write for our circular "P", giving full details of this "mechanical man". Also ask for Bulletin "14-P", featuring our complete line of scientific AC-ME equipment.

The Refinery Supply Co.

621 E. Fourth Street Tulsa, Okla.
Branch: 3404 Main St., Dallas, Tex.
Pacific Coast Representative:
The Braun Corporation
363 New High St. Los Angeles, Calif.

FOR ANY WIRE LINE DRILLING CLAMP
it's better

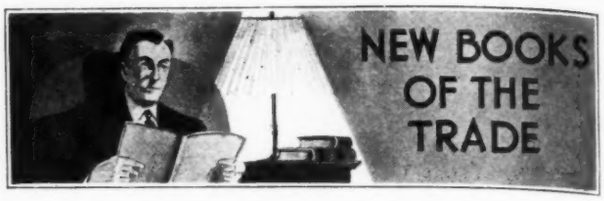
ACME
Non-Fouling Safety Link
Safer than the safest link you ever used
Easier to handle Strength to spare
ON SALE AT LEADING SUPPLY STORES
Manufactured by
Acme Fishing Tool Co., Parkersburg, W. Va.
"Peak Quality Only"

Quasi-Arc

COVERED WELDING RODS

QUASI-ARC Electrodes are unequalled for boiler welding or other work subject to stresses at high temperatures and for joints requiring high resistance to shock and fatigue caused by alternating stresses. Write for technical folders describing the unique features of Quasi-Arc welding.

QUASI-ARC INCORPORATED
11 West 42nd St., New York
Representatives in 27 of the World's Largest Industrial Centers



Structure of Typical American Oil Fields

This work published by the American Association of Petroleum Geologists contains two volumes. The first volume consists of thirty papers on the program of the twelfth annual convention of the Association at Tulsa on March 24, 25 and 26, 1927.

Volume one also has a description by thirty-nine authors of the typical oil field structures in thirteen states, namely, Arkansas, California, Indiana, Kansas, Kentucky, Louisiana, Michigan, New Mexico, Ohio, Oklahoma, Tennessee, Texas and West Virginia.

Volume two contains forty new papers prepared by a large number of authors describing typical fields in Arkansas, California, Colorado, Illinois, Kansas, Louisiana, Montana, New York, Oklahoma, Pennsylvania, Texas, West Virginia and Wyoming.

These two books may be obtained from the American Association of Petroleum Geologists at Box 1852, Tulsa.

Oil Fields in the United States

Walter A. Ver Wiebe, Ph. D., professor of geology at the University of Wichita, is the author of "Oil Fields of the United States."

It is a scientific description of all the oil fields of the United States, setting forth complete data on every important area. Emphasis is given to the peculiar structural conditions which have controlled the accumulation of oil and gas in each section and district, as well as in certain typical fields and pools. The nature, thickness, and correlation of the oil horizons are most adequately treated. Other important topics, including the history of development, production statistics, first causes for development, gravity of oil produced, are all broadly discussed. The book is published by McGraw-Hill Co.

Increasing the Recovery of Petroleum

Lieutenant-Commander Wentworth H. Osgood, U. S. N., has combined some unusually interesting data on methods of increasing the recovery of petroleum.

The title of the work is "increasing the Recovery of Petroleum" and it is published in two volumes. The books are a comprehensive work presenting in compact form the latest data on many phases of petroleum engineering and production practice.

The section on thermo-dynamics is especially interesting. The books are published by McGraw-Hill Co.

Superheater for Oil-Country Boilers

A most interesting bulletin on the Elesco Superheater for oil-country boilers has been prepared by The Superheater Company of New York City.

This 16-page illustrated bulletin tells the effect of superheated steam in oil-well drilling operations, explains what superheated steam is and how steam is superheated, and the apparatus for superheating.

One chapter is devoted to the application of Elesco Superheaters to oil-country boilers, going into detail on the installation and working instructions for the boilers.

Anderson-Prichard Oil Corp.

Seventh Floor—Colcord Bldg.
OKLAHOMA CITY, OKLA.

PRODUCERS
AND
REFINERS

GASOLINE
NAPHTHA
KEROSENE
FUEL OIL

AMERADA PETROLEUM CORPORATION

Producers of

Crude Oil

Manufacturers of

Absorption Gasoline

TULSA, OKLAHOMA

New Editorial Features

With this issue of The Petroleum Engineer we are inaugurating the policy of giving in condensed form illustrated information relating to major activities in the production and pipe line branches of the industry. Beginning next month refining and natural gasoline manufacturing will be added. This service will enable the busy operating man to keep abreast of developments in all branches of the industry without reading yards of extraneous matter to get the essential facts. Watch for these features in each issue.

THE PETROLEUM ENGINEER

MINNEHOMA Oil and Gas Company

PRODUCERS
of
OIL and GAS

7th Floor, ATLAS LIFE BUILDING
TULSA, OKLAHOMA

DEEP-ROCK
ABSORPTION OILS

Uniform Specifications

Guaranteed Quality

Next to efficient plant equipment, quality Absorption Oil is the essential factor affecting the maximum extraction of gasoline from casinghead gas.

For consistent results, this quality Absorption Oil must be made to uniform specifications.

Deep-Rock Absorption Oils are so made.

For equipment requiring it, a new Special Deep-Rock Absorption Oil of low molecular weight is now available. This Special Absorption Oil is made with the same care by the same organization that makes the Standard Deep-Rock Absorption Oil, long respected for its uniform specifications.

DEEP-ROCK

LUBRICATING OILS, COMPOUNDS AND GREASES

of unsurpassed quality ... available to drilling outfits in the Mid-Continent Field. Our many years of experience qualify us as consultants in drilling lubrication. Write today.

Investigate these characteristics of Deep-Rock Absorption Oils:

Maximum concentration of solute. Maximum carry-over into run down tanks.

Minimum make-up requirements.

Low pour test permitting year 'round operation.

Absence of emulsifying bodies.

Maximum customer satisfaction.

Write for detailed information regarding these Absorption Oils and other products of the Deep Rock Research Laboratories.

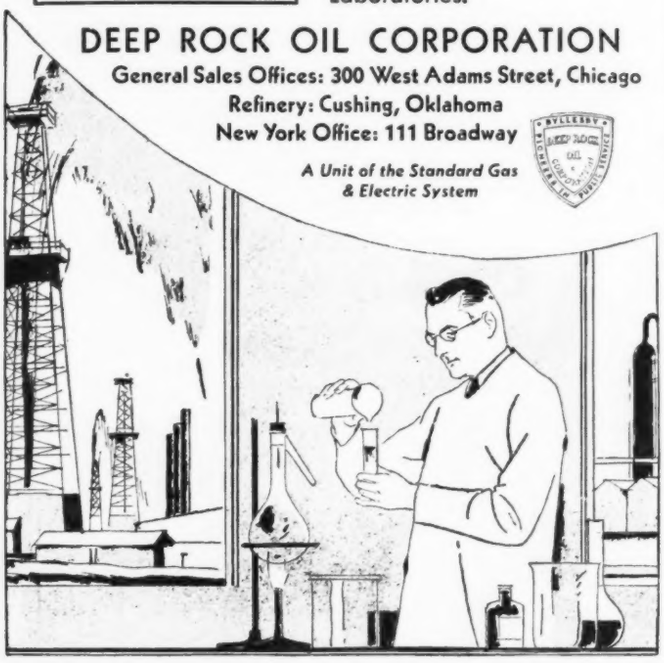
DEEP ROCK OIL CORPORATION

General Sales Offices: 300 West Adams Street, Chicago

Refinery: Cushing, Oklahoma

New York Office: 111 Broadway

A Unit of the Standard Gas & Electric System



Foxboro Controlled Valve Pamphlet

A FINELY prepared pamphlet of The Foxboro Company, Foxboro, Mass., on the company's V-port controlled valves is being distributed at this time.

The purpose of the book is to give the correct knowledge of controlled valve reaction, so that it may be useful to field men in planning new installations or in solving old problems. One chapter is devoted to controlled valve computation to aid operators in obtaining better control.

New American Iron & Machine Catalog Sheets

THE American Iron & Machine Works Company, Oklahoma City, has published some new sheets for its catalog. These are sheets Nos. 3, 10, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 and 31. The sheets are of the loose-leaf type, made to be inserted in the company's catalog, which has been distributed.

A number of these sheets are cross-cut blue-print drawings, showing clearly the construction and operating means of the various equipment being discussed.

These sheets may be obtained from The American Iron & Machine Works Company.

Michigan Screw-Lift Valve Booklet

THE Michigan Valve & Foundry Co., of Detroit, has printed a booklet illustrating its improved "screw-lift" valve. This new screw-lift valve is said to give greater strength and wearing qualities on the moving parts. The valve can be readily repacked while in service and under full pressure without jeopardizing the safety of the operator.

This and many other details of the valve are illustrated and explained in this booklet.

Baash-Ross Supplementary Catalog Sheets

THE Baash-Ross Tool Company, Los Angeles, Calif., has published supplementary pages 75, 76, 77 and 78 for its loose-leaf catalog. These sheets describe the star wheel casing perforator and the double string finger punch perforator.

The former is designed for perforating a single string of casing in the well and the latter for perforating two strings of casing or a single string with cement back of it.

Both tools are available on a rental basis at all times in the Baash-Ross shops. A corps of experienced operators is maintained. The tools are for sale for export only.

Westinghouse Has New Leaflet

THE Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has published a new leaflet, No. L-20470, entitled Electrical Pumping of Oil.

This booklet includes data for the proper selection of pumping equipment, whether for individual well or group pumping. Features of electrical drives are listed and application details in addition to several installation photographs illustrate this leaflet.

Copies may be obtained from the company.

Dardelet Threadlock Laboratory Test

THE testing laboratories, Department of Civil Engineering, of Columbia University in the city of New York, have completed a report upon the effect of length of thread exposure upon the static tensile strength and energy to rupture of Dardelet thread and nut connection.

This report is quite interesting and can be secured from the Dardelet Threadlock Corporation, 120 Broadway, New York City.

MID-CO NIPPLES

ARE

Safe and Durable

There is a growing preference for Mid-Co Nipples, due to the economy they effect. They are strong, uniform and carefully threaded. They will outlast any ordinary nipple, yet cost no more.

The nipple of green is the nipple that's seen

MID-CO PIPE & SUPPLY CO., Inc.

MANUFACTURERS

Guthrie and Frisco Tracks Tulsa, Oklahoma

There's a Nu-Alloy Ball and Seat for any field condition and any size of type valve.

Warehouse Stocks: Houston, San Antonio and Wichita Falls, Texas; Tulsa, Oklahoma; El Dorado, Arkansas; Coffeyville, Kansas.

Within two hours after your order is taken, your Nu-Alloy Balls and Seats will be on the way! Have you our catalog? Write for it.

PETROLEUM EQUIPMENT CO.

OF TEXAS, Incorporated

« « Jon R. Long, Manager » »

Plant and Office: Fort Worth, Texas

The MASTER

Pipe Line Coating

The Master Pipe Line Coating consists of four elements:

(1) Dearborn Pipe Mill Coat. The object of this coat is to give protection to pipe in transit by placing a rust inhibitor on the steel immediately after manufacture. It is soluble in NO-OX-ID thus giving NO-OX-ID a perfect bond when field application is made.

(2) NO-OX-ID "G" Special, the rust preventive unequalled which combines chemical rust inhibition and mechanical soft, non-drying protection. It is gray in color, making possible ease of inspection.

(3) NO-OX-ID-IZED Wrapper. There are three types of wrapper—a range which handles every soil condition. The wrapper is applied spirally.

(4) NO-OX-ID Service Coat applied warm at a flowing consistency. It cannot crack and resists both chemical and physical soil attack.

This constitutes the Master Pipe Line Coating based on all that has been valuable in research and experience in pipe line protection. It marks the greatest advance made to date in the fight against rusting, pitting and corrosion.

Investigate!

DEARBORN CHEMICAL COMPANY

310 S. Michigan Avenue, Chicago 205 East 42nd Street, New York

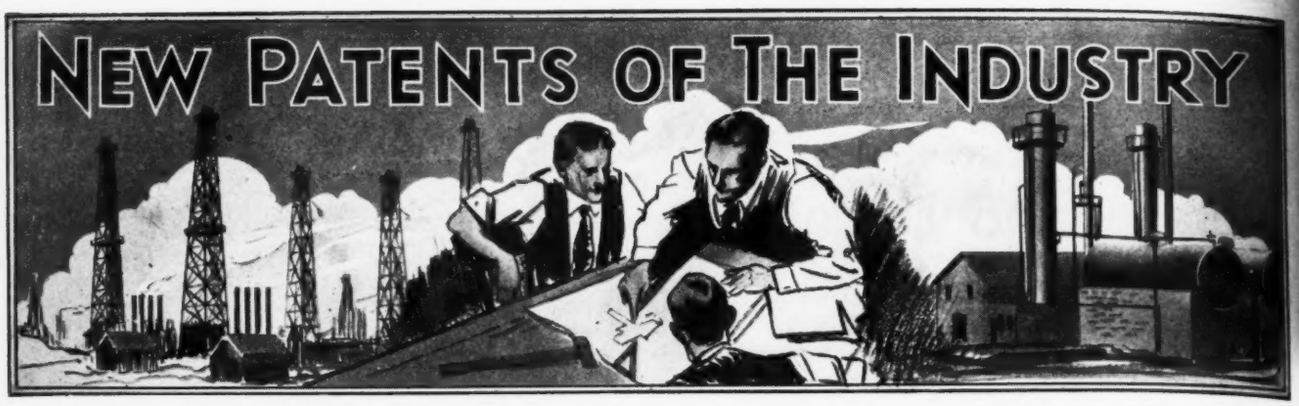
Canadian Offices and Factory: 2454-64 Dundas Street, West, Toronto

NO-OX-ID

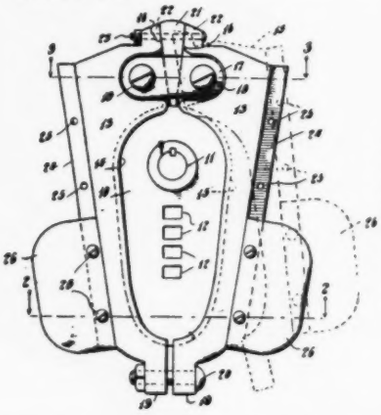
IRON + OX = RUST

TRADE MARK

The Original Rust Preventive

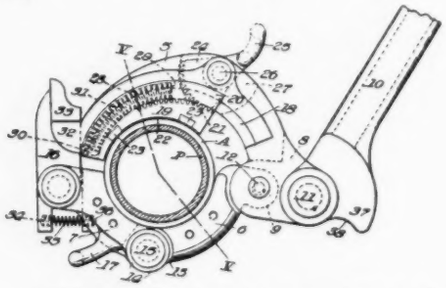


1,775,390. OIL-WELL PUMPING AND DRILLING RIG. CARL EURIT, Tulsa, Okla. Filed Feb. 8, 1929. Serial No. 338,494. 3 Claims. (Cl. 74—71.)

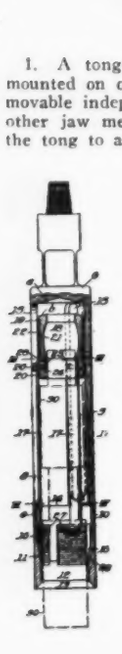


1. In combination with a crank a yoke embracing the crank and coplanar therewith, counterweights adjustable longitudinally of the sides of the yoke, said yoke being formed in two sections, a pivotal connection between the sections at one end, a securing means connecting the opposite ends thereof.

1,775,343. BREAK-OUT TONGS. EDGAR E. GREVE, Bellevue, Pa., assignor to Oil Well Supply Company, Pittsburgh, Pa., a Corporation of Pennsylvania. Filed July 26, 1928. Serial No. 295,425. 6 Claims. (Cl. 81—53.)



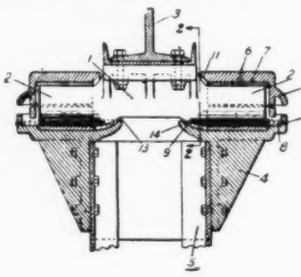
1. A tong including a plurality of jaw members, a lever pivotally mounted on one of the jaw members with a single point connection and movable independently of the said member for imparting a blow to the other jaw member upon rotation of the lever, and means for securing the tong to a joint member independently of the lever.



1,775,328. FISHING TOOL. FERDINAND J. SPANG, Butler, Pa., assignor to Spang and Company, Butler, Pa., a Corporation of Pennsylvania. Filed April 18, 1928. Serial No. 270,949. 5 Claims. (Cl. 294—102.)

1. In a fishing tool, the combination with a hollow body member, of means provided with gripping jaws disposed and movable within the body, said means including an expansible member having a serrated exterior portion operable to effect a binding engagement with the body by a jarring operation, said means being freely movable within the body prior to the jarring operation.

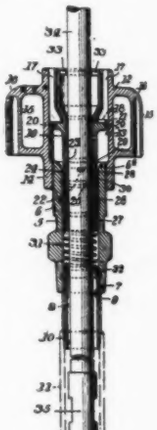
1,775,628. WALKING-BEAM BEARING. RICHARD R. BLOSS, ELMER B. MAURER, and SYLVESTER B. CREAMER, Columbus, Ohio, assignors to The International Derrick & Equipment Company, Columbus, Ohio, a Corporation of Ohio. Filed April 10, 1928. Serial No. 268,939. 3 Claims. (Cl. 308—121.)



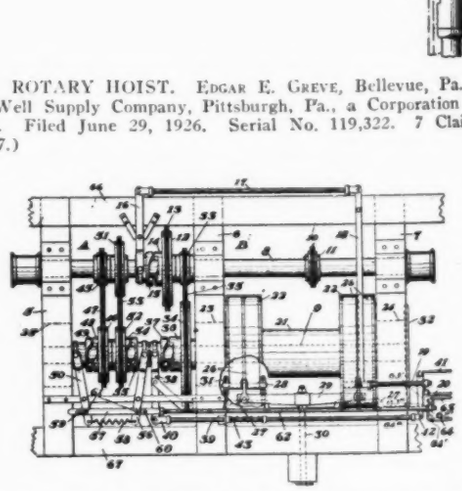
3. A walking beam center support comprising a walking beam saddle having trunnions on the opposite sides thereof, spaced side irons having base portions which form a bearing support for said trunnions, cap members forming the tops of such bearings, the bearing support for each trunnion having an oil reservoir at each end, two of said oil reservoirs being positioned at a higher level than the others, and shields for the oil reservoirs at the higher level, said shields being formed integrally with said cap members.

1,775,342. STUFFING BOX. EDGAR E. GREVE, Bellevue, Pa., assignor to Oil Well Supply Company, Pittsburgh, Pa., a Corporation of Pennsylvania. Filed Jan. 18, 1927. Serial No. 161,937. 7 Claims. (Cl. 286—30.)

1. In a stuffing-box, a hollow body member, a removable hollow cap-member mounted thereon, a lubricant reservoir detachably mounted within and removable through the cap-member, said reservoir and cap-member having co-operating locking means, comprising a lug and slot construction, and packing means in the body member.



1,775,341. ROTARY HOIST. EDGAR E. GREVE, Bellevue, Pa., assignor to Oil Well Supply Company, Pittsburgh, Pa., a Corporation of Pennsylvania. Filed June 29, 1926. Serial No. 119,322. 7 Claims. (Cl. 254—187.)



1. In a hoist for drilling rigs, a hoist frame, a drum-shaft, clutch mechanisms for imparting first, second and third speeds to the drum-shaft, actuating means for the first speed clutch mechanism, and common actuating means for the second and third clutch mechanisms including a horizontally movable member, and spring actuated pivoted members connecting said horizontal member and the clutch members.